5-2410-234-14+P-1/986

TM 5-2410-234-14&P-1

TECHNICAL MANUAL

OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL
(INCLUDING REPAIR PARTS INFORMATION AND SUPPLEMENTAL MAINTENANCE
AND REPAIR PARTS INSTRUCTIONS)

TRACTOR, FULL TRACKED, LOW SPEED, HEAVY DRAWBAR PULL, (SIZE T-11) W/ANGLE DOZER, WINCH AND ROPS CATERPILLAR MODEL D8K-8A-58 (CCE)

NSN 2410-00-574-7597

AND W/BULLDOZER (SEMI-U-TILT), RIPPER
AND ROPS CATERPILLAR MODEL D8K-8S-8 (CCE)

NSN 2410-00-574-7598

This copy is a reprint which includes current pages from Change 1.

HEADQUARTERS, DEPARTMENT OF THE ARMY

JUNE 1981

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TM 5-2410-234-14&P-1
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CHANGE
NO. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, *3 November 1986*

TECHNICAL MANUAL

OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL (INCLUDING REPAIR PARTS INFORMATION AND SUPPLEMENTAL MAINTENANCE AND REPAIR PARTS INSTRUCTIONS)

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TM 5-2410-234-14&P-1, 30 June 1981 is changed as follows:

1. Chapter 7, Repair Parts, in this manual has been superseded by TM 5-2410-234-20P, Organizational Maintenance Repair Parts and Special Toole Lists, and TM 5-2410-234-34P Direct Support and General Support Maintenance Repair Parts and Special Tools Lists.

2. File this change sheet in front of the publication for reference purposes.

By Order of the Secretary of the Army:

JOHN A. WICKHAM, JR.
General, United States Army
Chief of Staff

Official:

R.L. DILWORTH
Brigadier General, United States Army
The Adjutant General

Distribution:

To be distributed in accordance with DA Form 12-25 A , Operator's Organizational, Direct Support and General Support Maintenance Requirements for Tractor, Full Tracked, Low Speed with Angle Dozer Models D8K-8A-58, D8K-8S-8.

READEX FICHE best copy available

WARNING

The proper and safe lubrication and maintenance procedures for this machine, recommended by Caterpillar, are outlined in the LUBRICATION & MAINTENANCE GUIDE for this machine. Improper performance of lubrication or maintenance procedures is dangerous and could result in injury or death. Read and understand the LUBRICATION & MAINTENANCE GUIDE before performing any lubrication or maintenance.

WARNING

To avoid possible weakening of this ROPS, consult a Caterpillar dealer before altering this ROPS in any way.

WARNING

The protection offered by this ROPS will be impaired if it has been structurally damaged or has been involved in an overturn accident.

WARNING

Seat adjustment should be checked at the beginning of each shift and when operators change.

WARNING

Always use seat belts when operating machine.

WARNING

Always check condition of seat belt and connecting brackets.

WARNING

Attach ground cable last, and remove first, to prevent sparks from occurring near the battery which could cause battery vapors to explode. Attach ground cable from booster battery to frame of machine to be started at a point away from, and below, the battery on the machine to be started.

WARNING

Use starting fluid sparingly. Follow manufacturer's instructions carefully.

WARNING

Do not store starting fluid in operator's compartment.

WARNING

Keep tractor under control at all times. Do not neutralize transmission or forward-reverse lever, or disengage flywheel clutch to allow machine to coast.

WARNING

Select gear range necessary before starting downgrade. Do not change gears while going downhill.

WARNING

Do not allow tractor to coast downhill.

WARNING

When load is pushing tractor, put gear selector in first speed before starting downhill.

WARNING

Do not release clutch or shift transmission while moving.

WARNING

Use extra caution when crossing side hills, ridges, logs and ditches.

WARNING

Make certain personnel are clear of cable when there is a load on the cable. Cable can break and cause personal injury.

WARNING

Exercise care with suspended loads. If engine speed is too low, the weight of the load may cause it to drop, even though the winch is in the Reel In position.

WARNING

Check travel route for overpass clearances. Make sure there will be adequate clearance if vehicle being transported is equipped with ROPS, cab or canopy.

WARNING

If the rack setting or the high idle speed is higher than the setting in the book RACK SETTING INFORMATION for the "altitude" (height above sea level) at which the engine is operated, there can be damage to the engine or to parts of the turbocharger.

WARNING

Be sure to make an adjustment to the regulator so the air supply in the tank is a maximum of 15 psi (1.05 kg/cm^2).

WARNING

When making the (cooling system) checks, fasten the transmission in neutral, put the parking brakes on and lower all equipment. Make all checks at engine LOW IDLE and on the side of the radiator opposite the fan. Wear eye protection.

WARNING

Never disconnect any charging unit circuit or battery circuit cable from battery when the charging unit is producing a charge.

WARNING

Disconnect batteries before performance of any service work.

WARNING

The (valve) locks can be thrown from the valve when the valve spring compressor is released. Make sure the locks are in the correct position on the valve.

WARNING

When (transmission) tests must be done in a closed area, activate the brakes and use blocks to prevent the machine from moving during the tests. Let only approved personnel on the machine. Keep other personnel off the machine and in view of the operator.

WARNING

Do not make any adjustments to the (transmission) linkage with the engine running.

WARNING

The adjuster cylinder for the track is under high hydraulic pressure. Do not visually inspect the relief valve to see if grease is being released. Check the adjuster cylinder that it moves to the rear into the front pilot for the recoil springs. Use this warning any time that the track is loosened or tightened.

WARNING

Make sure the hydraulic jack is tight against the track roller frame when the track is lifted.

WARNING

Make sure the hydraulic pressure in the track adjusting mechanism is completely released and the cylinder can be moved to the rear into the front pilot for the recoil spring before making a separation of the track or installing the track adjusting mechanism. On machines with badly worn tracks, it is possible for the hydraulic track adjuster to have a maximum forward adjustment and the stop will be against the front support for the track roller frame. The hydraulic track adjuster is under high pressure. Do not visually inspect the relief valve to see if grease is being released. Check the adjuster cylinder to see that it moves to the rear into the front pilot for the recoil spring. Use this warning any time that the track is loosened or tightened.

WARNING

Do not remove the front cover for the recoil springs until Step 4 (spring compression) is completed. If the front pilot for the recoil spring is broken, the procedure on page II-40 must not be used. See RECOIL SPRINGS (with broken pilots) for correct procedures.

WARNING

The recoil springs are assembled under a force of several tons. This force is released against legs during disassembly. Caution must be used to make sure the correct tooling is used and the correct procedure is followed.

WARNING

The recoil springs are assembled under a force of several tons. This force is released against legs during assembly. Caution must be used to make sure the correct tooling is used and the correct procedure is followed.

WARNING

Do not remove the hoist from the track roller frame at this time (following Step 6 of track roller frame disassembly).

WARNING

Make sure the track roller frame does not hit the equalizer bar when it is removed. Weight of the track roller frame is 8000 lb. (3629 kg).

WARNING

Do not hit the equalizer bar when the track roller frame is put in position.

WARNING

The recoil springs are under several tons of force. Do not remove cover until force is controlled by (proper) tooling.

WARNING

Do not put more than 50 ton (45t) of force on (pilot) bolt.

WARNING

(Valve assembly) Cover is under spring tension. Hold the cover in position when the bolts that hold it to the housing are removed.

WARNING

The access cover is under spring pressure. Hold the cover when the bolts that hold it are removed.

WARNING

Exercise care with suspended loads; if engine speed is too low, the weight of the load may cause it to drop, even though the winch is in the REEL IN position.

WARNING

Do not underwind cable onto winch drum unless the winch has been modified to operate in this manner.

WARNING

When testing or making an adjustment to the hydraulic system, move the machine to a location away from other moving machines. The operator must be sure that other personnel are not near the machine when the engine is running and he is making tests.

WARNING

To avoid possible weakening of the ROPS (Rollover Protective Structure), consult a Caterpillar Dealer before altering the ROPS in any way. The protection offered by the ROPS will be impaired if it has been subjected to structural damage or has been involved in an overturn accident.

WARNING

When using pressure air, wear safety glasses and protective clothing. Maximum air pressure must be below 30 psi (2 kg/cm^2).

WARNING

(Corrosion) Inhibitor contains alkali, avoid contact with skin and eyes.

WARNING

Never service air cleaners with engine running.

WARNING

If track is sealed and lubricated type, secure track with chain before separating links. Sealed and lubricated track is very flexible. When disconnected, it can move and cause injury.

WARNING

Never visually inspect relief valve or fill valve to see if grease is escaping. Always observe the track to see if it has loosened.

WARNING

Never service air cleaners with engine running.

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TM 5-2410-234-14&P-1

TECHNICAL MANUAL
No. 5-2410-234-14&P-1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, *30 June 1981*

OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL (INCLUDING REPAIR PARTS INFORMATION AND SUPPLEMENTAL MAINTENANCE AND REPAIR PARTS INSTRUCTIONS)

FOR

TRACTOR, FULL TRACKED, LOW SPEED, HEAVY DRAWBAR PULL, (SIZE T-11) W/ANGLE DOZER, WINCH AND ROPS

CATERPILLAR MODEL D8K-8A-58 (CCE)
NSN 2410-00-574-7597
AND
W/BULLDOZER (SEMI-U-TILT), RIPPER AND ROPS
CATERPILLAR MODEL D8K-8S-8 (CCE)
NSN 2410-00-574-7598

REPORTING OF ERRORS

You can improve this manual by recommending improvements using DA Form 2028 (Recommended Changes to Publications and Blank Forms) or DA Form 2028-2 located in the back of this manual. Mail the form direct to Commander, US Army Tank-Automotive Command, ATTN: DRSTA-MBS, Warren, MI 48090. A reply will be furnished direct to you.

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	2.	ENGINE
Section	I.	Specifications
	II.	Systems Operation, Testing and Adjusting
CHAPTER	3.	POWER TRAIN
Section	I.	Specifications
	II.	Systems Operation, Testing and Adjusting
	III.	Disassembly and Assembly
CHAPTER	4.	VEHICLE SYSTEMS
	5.	LUBRICATION AND MAINTENANCE
Section	I.	Direct Drive Tractor
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APPENDIX	A.	REFERENCES
	B.	WARRANTY GUIDE LINES
	C.	MAINTENANCE ALLOCATION CHART
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	F.	MAINTENANCE AND OPERATING SUPPLIED
	G.	SAMPLE FORMAT, DA FORM 2765-1, NSN OR PART NUMBER REQUEST
	H.	SAMPLE FORMAT, MILSTRIP REQUISITION FOR CCE (NSN)
	I.	SAMPLE FORMAT, MILSTRIP REQUISITION FOR CCE (NON-NSN)
	J.	SAMPLE FORMAT, MILSTRIP REQUISITION FOR CCE (NON-NSN) (MANUAL)
	K.	DDS PROJECT CODES
	L.	PRESCRIBED LOAD LIST (PLL) AUTHORIZED STOCKAGE LIST (ALS)
	M.	PREVENTIVE MAINTENANCE CHECKS AND SERVICES

N. WALK-AROUND INSPECTION
O. SUPPLEMENTAL INFORMATION
P. CATERPILLAR DEALER LOCATIONS (CONUS & O/CONUS)

VOLUME II

CHAPTER 7. REPAIR PARTS
Section I. D342 Vehicular Engine
II. D8K Tractor (D342 Engine)
III. D8K Tractor
IV. 183B Hydraulic Control
V. Bulldozers (8A, 8S & 8U)
VI. 58 & 59 Winch
VII. Ripper

This technical manual is an authentication of the manufacturers' commercial literature and does not conform with the format and content specified in AR 310-3, Military Publications. This technical manual does, however, contain available information that is essential to the operation and maintenance of the equipment.

CHAPTER 1
OPERATOR'S GUIDE

SEBU5473-01

OPERATOR'S GUIDE

D7G, D8K, D9H TRACTORS

SERIAL NUMBERS

64V1-UP
65V1-UP
66V1-UP
76V1-UP
77V1-UP
90V1-UP
91V1-UP
92V1-UP
44W1-UP
45W1-UP
72W1-UP

⚠ IMPORTANT SAFETY NOTICE

Most accidents involving machine operation are caused by failure to observe basic safety rules or precautions. An accident can often be avoided by recognizing potentially hazardous situations before an accident occurs.

Improper operation is dangerous and could result in injury or death.

READ AND UNDERSTAND ALL SAFETY PRECAUTIONS AND WARNINGS BEFORE OPERATING THIS MACHINE.

Basic safety precautions are outlined in the SAFETY section of this Guide and in the description of operations where hazards exist. Warning labels have also been put on the machine to provide instructions and to identify specific hazards which, if not heeded, could cause bodily injury or death to you or other persons. These warnings in the Guide and on the machine labels are identified by the symbol ⚠ WARNING

Operations that may result only in machine damage are identified by CAUTION labels on the machine and in the Guide.

Caterpillar cannot anticipate every possible circumstance that might involve a potential hazard. The warnings in this Guide and on the machine are therefore not all inclusive. If an operation is not performed as specifically recommended by Caterpillar, you must satisfy yourself that it is safe for you and others. You should also ensure that the machine will not be damaged or made unsafe by the method of operation you choose.

⚠ WARNING

The proper and safe lubrication and maintenance procedures for this machine, recommended by Caterpillar, are outlined in the LUBRICATION & MAINTENANCE GUIDE for this machine.

Improper performance of lubrication or maintenance procedures is dangerous and could result in injury or death. Read and understand the LUBRICATION & MAINTENANCE GUIDE before performing any lubrication or maintenance.

FOREWORD

This guide is a reference for the new operator and a refresher for the experienced one. Read — Study — and keep it handy.

Illustrations help guide the operator through the correct procedures of checking, starting, operating and stopping the vehicle and attachments.

Operating techniques outlined in the guide are basic. Skill and techniques develop as the operator gains knowledge of the vehicle and its capabilities.

Your safety and the safety of others depends upon care and judgment in the operation of this vehicle. A careful operator is good insurance against an accident.

Some photographs in this publication may show details or attachments that may be different from your unit. Also, the Rollover Protective Structure (ROPS), for some photographs may have been removed for illustrative purposes.

Continuing improvement and advancement of product design may cause changes to your machine which may not be included in this publication. Each publication is reviewed and revised, as required, to update and include these changes in later editions.

When a question arises regarding your Caterpillar product, or this publication, please consult your Caterpillar dealer for the latest available information.

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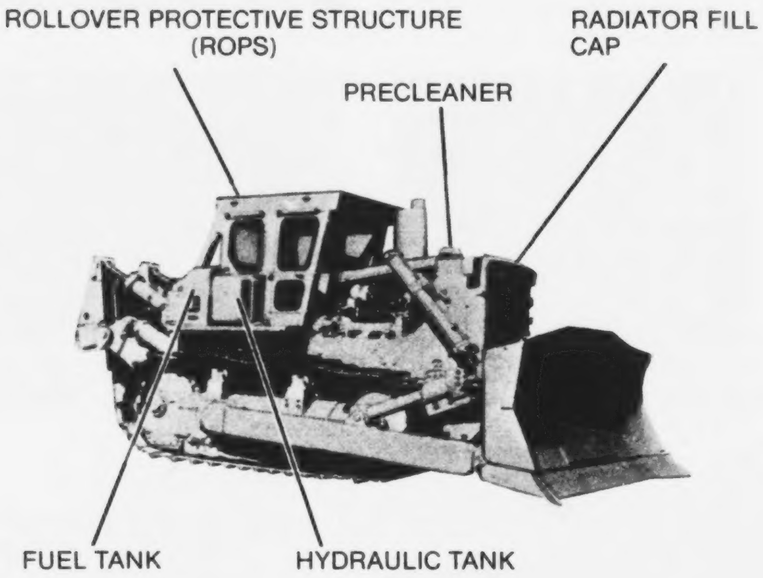
TRACTOR

General Locations



ROLLOVER PROTECTIVE STRUCTURE (ROPS)
RADIATOR FILL CAP
PRECLEANER
FUEL TANK
HYDRAULIC TANK

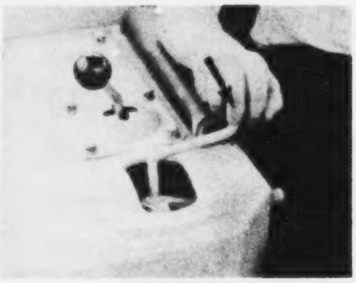
SAFETY ⚠ **THIS SYMBOL WARNS OF POSSIBLE PERSONAL INJURY**

⚠ WARNING

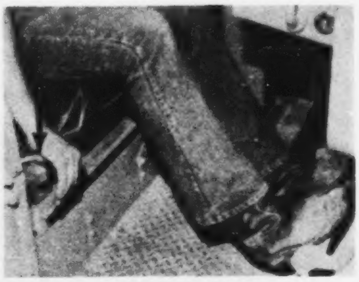
To avoid possible weakening of this ROPS, consult a Caterpillar dealer before altering this ROPS in any way.

⚠ WARNING

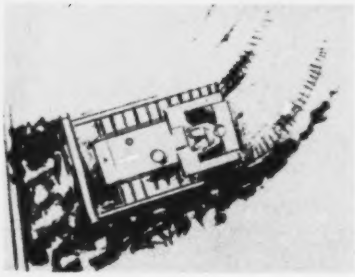
The protection offered by this ROPS will be impared if it has been structurally damaged or has been involved in an overturn incident.



Lower or block equipment and stop engine before servicing.



Lower all equipment and set parking brake before leaving machine.



Stay safe distance from edge of cliff or overhang.

General

Clean steps, grab irons and operator's compartment.

Wear a hard hat, safety glasses and respirator as required by job conditions.

Do not wear loose clothing or jewelry that could catch on controls.

Report needed repairs.

Make sure clearance flags, lights and other required warnings are on machine when roading.

Know hand signals and who gives them.

Do not smoke while fueling machine or when near batteries.

Preparing to Operate

Clear all personnel from machine and surrounding area.

Clear obstacles from path of machine, note hazards such as wires and ditches.

Make certain all safety guards and covers are secured in place.

Adjust seat and fasten seat belt before operating.

Move all controls to HOLD before starting engine.

Move transmission to NEUTRAL and have brake lock engaged before starting engine.

Start engine in a well ventilated area.

Testing Controls

Test all controls for proper operation.

Test right and left steering while moving slowly.

Test brakes.

Test function of safety devices such as lights and backup alarm.

Mounting and Dismounting

To park machine, lower blade to ground and apply down pressure, engage parking brake.

Stop engine before leaving the machine.

Do not jump off machine. Use steps and grab irons.

Operating

Do not allow riders on the machine.

The operator must satisfy himself that no one will be endangered before, and while, backing the machine.

Observe all gauges frequently — investigate improper readings.

Know traffic pattern of the job and obey flagmen, road signs and signals.

Match speed with job conditions — do not coast.

Know stopping distance of your machine at any given speed. Regulate travel speed accordingly.

Carry blade close to ground.

Stop machine frequently at night, walk around and inspect machine — stay alert.

Road machine in forward direction, not reverse.

Stay clear of overhangs, electric wires, slide or other dangerous areas.

Use caution in crossing side hills, ridges, ditches, and other obstructions.

Use caution when working on hills, banks or slopes, to avoid tipping.

Stay a safe distance from edge of cliff or overhang.

Listen for unusual noises.

Report needed repairs noted during operation.

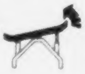
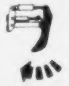
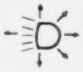
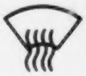
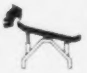
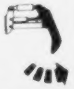
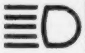
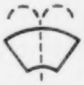
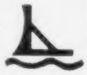
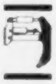
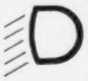
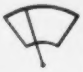
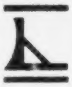
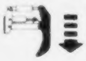
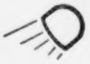
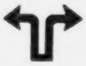
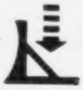
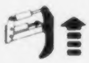
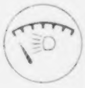
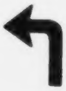
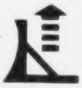
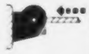
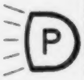
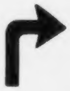
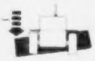
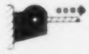
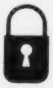
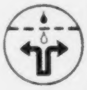
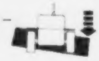
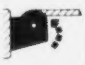
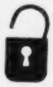
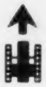
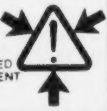
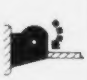
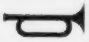
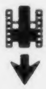
Shipping

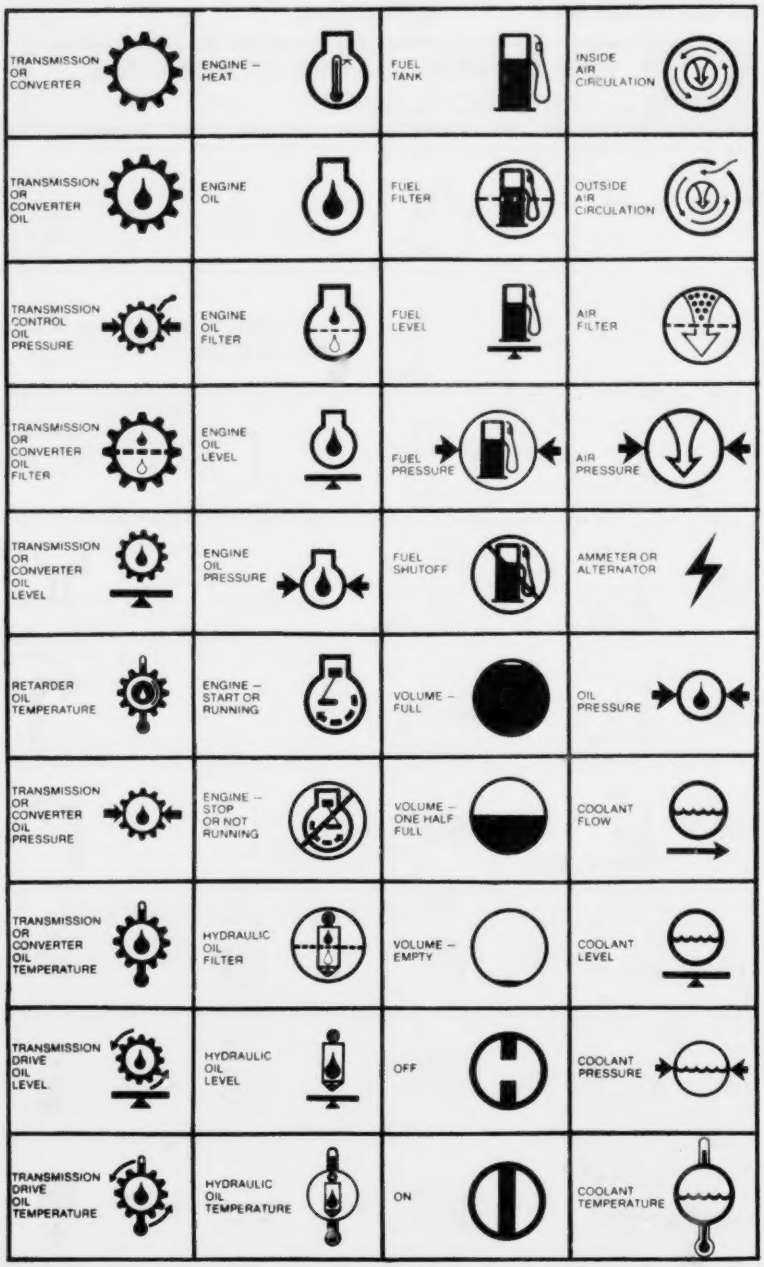
For shipping instructions consult your Caterpillar dealer.

SYMBOL IDENTIFICATION

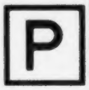
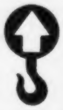
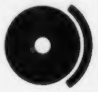
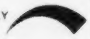
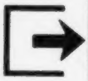
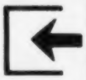
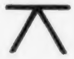
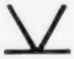
THESE PAGES EXPLAIN THE MEANING OF SYMBOLS THAT MAY APPEAR ON YOUR MACHINE.

THIS SYMBOL WARNS OF POSSIBLE PERSONAL INJURY

BULLDOZER – ANGLE LEFT 	RIPPER – ANGLE IN 	LIGHT – ALL 	WINDSHIELD DEFROSTER CONTROL 
BULLDOZER – ANGLE RIGHT 	RIPPER – ANGLE OUT 	LIGHT – BRIGHT 	WINDSHIELD WASHER CONTROL 
BULLDOZER – FLOAT 	RIPPER – HOLD 	LIGHT – DIM 	WINDSHIELD WIPER CONTROL 
BULLDOZER – HOLD 	RIPPER – LOWER 	LIGHT – FLOOD 	STEERING 
BULLDOZER – LOWER 	RIPPER – RAISE 	LIGHT – INSTRUMENT 	TURN – LEFT 
BULLDOZER – RAISE 	WINCH – REEL IN 	LIGHT – PARK 	TURN – RIGHT 
BULLDOZER – TILT – LEFT 	WINCH – REEL OUT 	LOCK 	STEERING OIL FILTER 
BULLDOZER – TILT – RIGHT 	WINCH – OVERWIND 	UNLOCK 	TRACTOR – FORWARD 
PRESSURIZED COMPARTMENT 	WINCH – UNDERWIND 	HORN CONTROL 	TRACTOR – REVERSE 

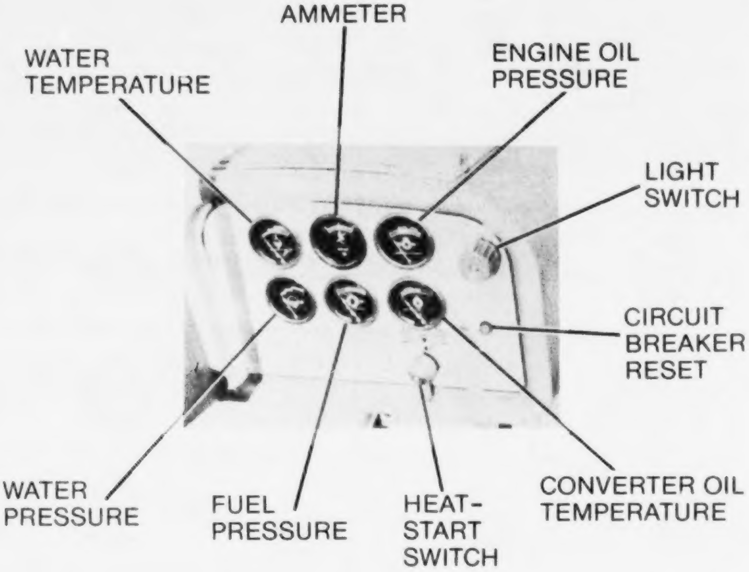


TRANSMISSION OR CONVERTER	ENGINE – HEAT	FUEL TANK	INSIDE AIR CIRCULATION
TRANSMISSION OR CONVERTER OIL	ENGINE OIL	FUEL FILTER	OUTSIDE AIR CIRCULATION
TRANSMISSION CONTROL OIL PRESSURE	ENGINE OIL FILTER	FUEL LEVEL	AIR FILTER
TRANSMISSION OR CONVERTER OIL FILTER	ENGINE OIL LEVEL	FUEL PRESSURE	AIR PRESSURE
TRANSMISSION OR CONVERTER OIL LEVEL	ENGINE OIL PRESSURE	FUEL SHUTOFF	AMMETER OR ALTERNATOR
RETARDER OIL TEMPERATURE	ENGINE – START OR RUNNING	VOLUME – FULL	OIL PRESSURE
TRANSMISSION OR CONVERTER OIL PRESSURE	ENGINE – STOP OR NOT RUNNING	VOLUME – ONE HALF FULL	COOLANT FLOW
TRANSMISSION OR CONVERTER OIL TEMPERATURE	HYDRAULIC OIL FILTER	VOLUME – EMPTY	COOLANT LEVEL
TRANSMISSION DRIVE OIL LEVEL	HYDRAULIC OIL LEVEL	OFF	COOLANT PRESSURE
TRANSMISSION DRIVE OIL TEMPERATURE	HYDRAULIC OIL TEMPERATURE	ON	COOLANT TEMPERATURE

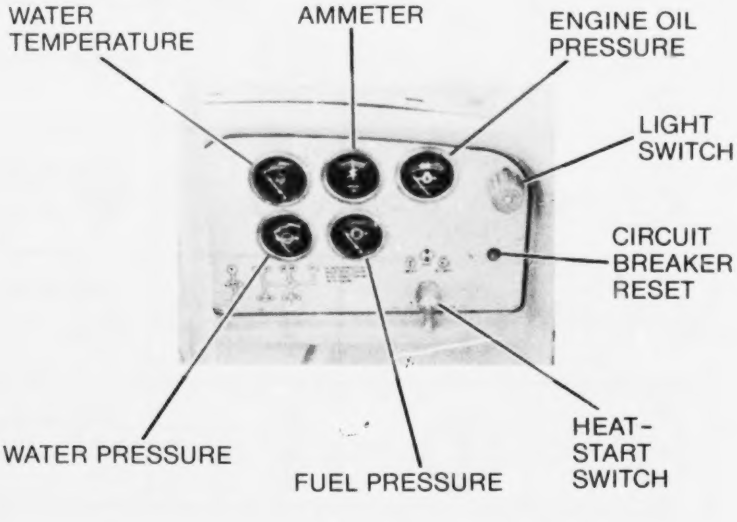
BRAKE – PARK 	LIFT POINT 	BRAKE 	CONTINUOUSLY VARIABLE 
DISENGAGE 	ENGAGE 	MAXIMUM 	MINIMUM 

OPERATOR'S COMPARTMENT

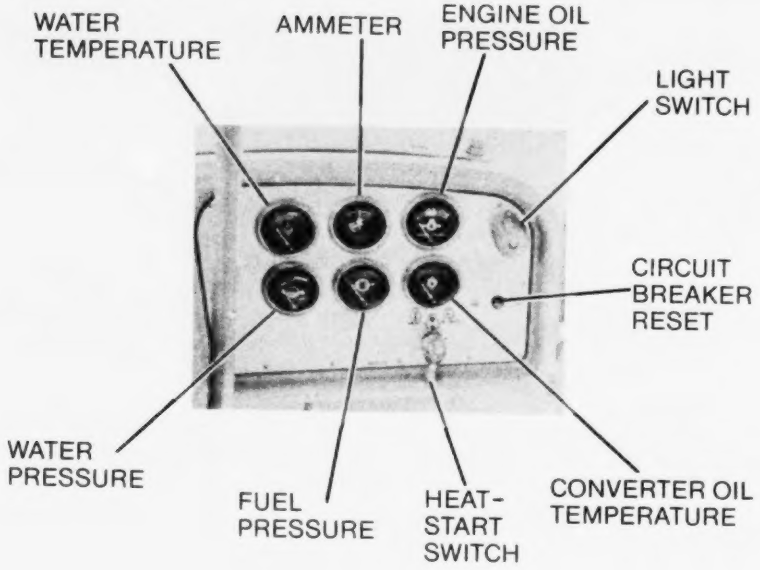
Gauges — D7G Power Shift


AMMETER
WATER TEMPERATURE
ENGINE OIL PRESSURE
LIGHT SWITCH
CIRCUIT BREAKER RESET
WATER PRESSURE
FUEL PRESSURE
HEAT-START SWITCH
CONVERTER OIL TEMPERATURE

D7G — Direct Drive


WATER TEMPERATURE
AMMETER
ENGINE OIL PRESSURE
LIGHT SWITCH
CIRCUIT BREAKER RESET
WATER PRESSURE
FUEL PRESSURE
HEAT-START SWITCH

D8K Power Shift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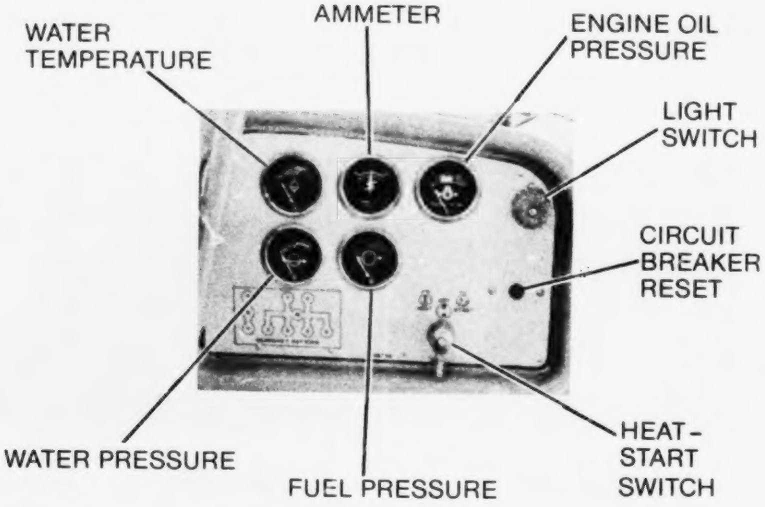
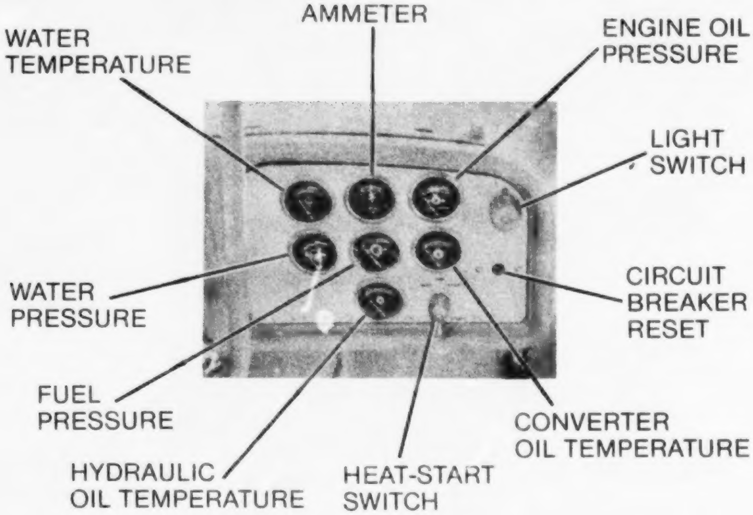
AMMETER
ENGINE OIL PRESSURE
LIGHT SWITCH
CIRCUIT BREAKER RESET
WATER PRESSURE
FUEL PRESSURE
HEAT-START SWITCH
CONVERTER OIL TEMPERATURE

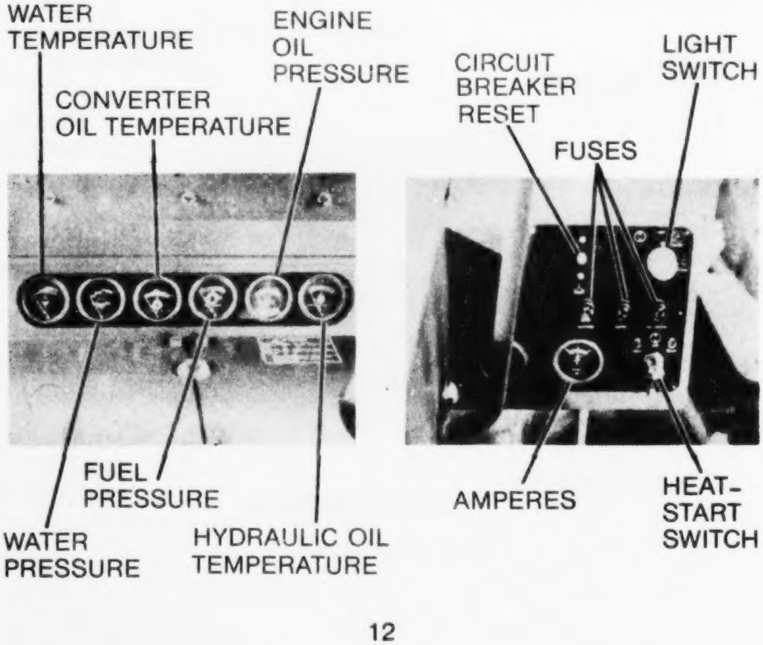
D8K Direct Drive

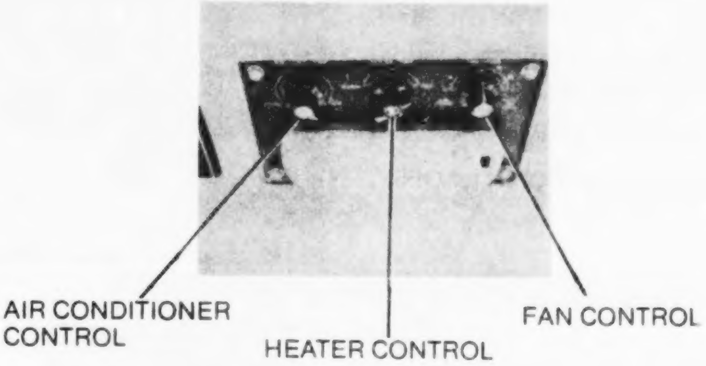

WATER TEMPERATURE
AMMETER
ENGINE OIL PRESSURE
LIGHT SWITCH
CIRCUIT BREAKER RESET
WATER PRESSURE
FUEL PRESSURE
HEAT-START SWITCH

D9H


WATER TEMPERATURE
AMMETER
ENGINE OIL PRESSURE
LIGHT SWITCH
WATER PRESSURE
CIRCUIT BREAKER RESET
FUEL PRESSURE
CONVERTER OIL TEMPERATURE
HYDRAULIC OIL TEMPERATURE
HEAT-START SWITCH

Modular Cab D7G, D8K, D9H


WATER TEMPERATURE
ENGINE OIL PRESSURE
CONVERTER OIL TEMPERATURE
CIRCUIT BREAKER RESET
LIGHT SWITCH
FUSES
FUEL PRESSURE
WATER PRESSURE
HYDRAULIC OIL TEMPERATURE
AMPERES
HEAT-START SWITCH



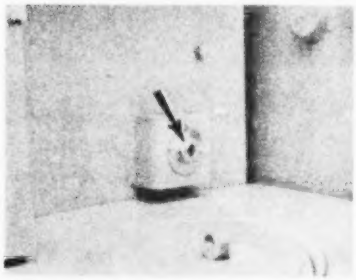
FAN – The FAN SWITCH has LOW, MEDIUM and HIGH speed for both AIR CONDITIONING and HEATING.

Turn control COUNTERCLOCKWISE for AIR CONDITIONING.

Turn control CLOCKWISE for HEATING or VENT.

HEATING – Turn control COUNTERCLOCKWISE for increased HEATING.

COOLING – Turn control COUNTERCLOCKWISE for increased COOLING.



Disconnect Switch

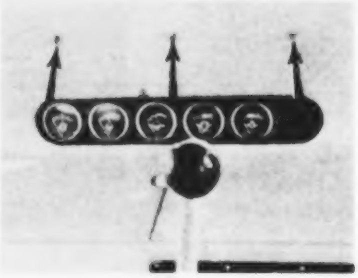
CAUTION

Never turn disconnect switch to off with engine running. This will damage the electrical system.

NOTE

Turn switch to OFF and remove key before leaving machine.

Modular Cab



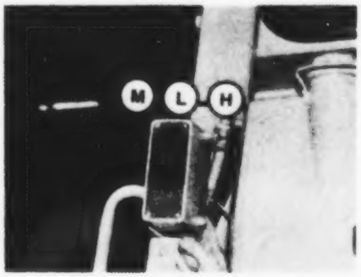
WINDSHIELD WIPER SWITCHES

Turn switches UP for ON.

Turn switches DOWN for OFF.

BACKUP ALARM

BACKUP ALARM should sound anytime TRANSMISSION SELECTOR LEVER is in REVERSE position.

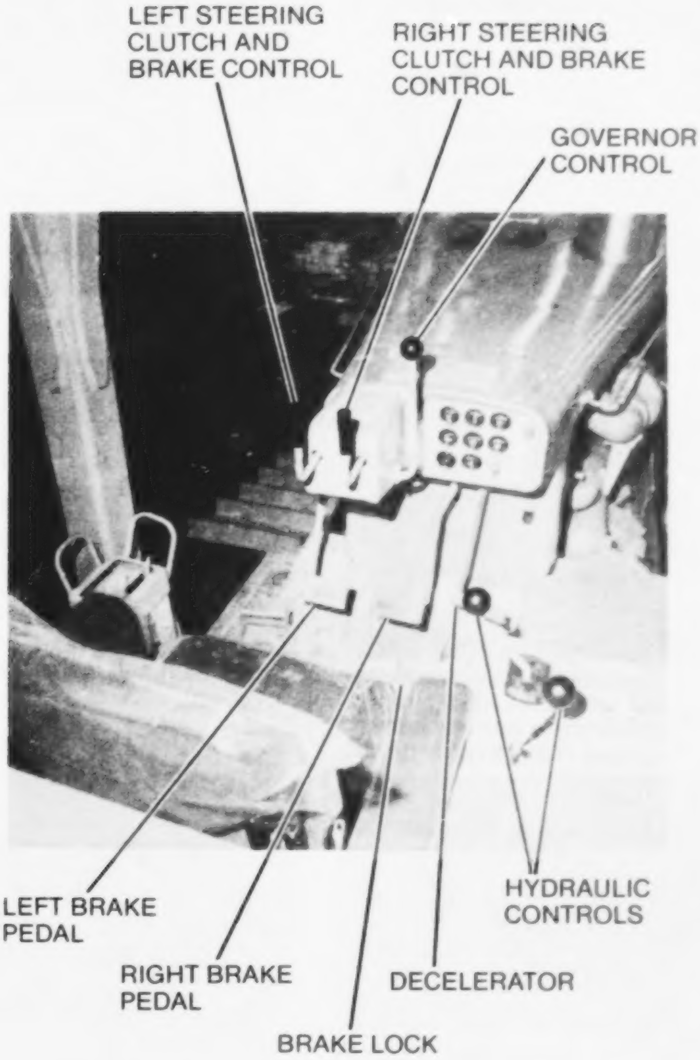


A 3 position switch at the rear of the BACKUP ALARM regulates its volume.

Ⓜ MEDIUM
Ⓛ LOW
Ⓗ HIGH

CONTROLS

Power Shift (D9H Shown)

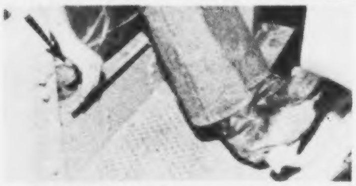

LEFT STEERING CLUTCH AND BRAKE CONTROL
RIGHT STEERING CLUTCH AND BRAKE CONTROL
GOVERNOR CONTROL
LEFT BRAKE PEDAL
HYDRAULIC CONTROLS
RIGHT BRAKE PEDAL
DECELERATOR
BRAKE LOCK

CONTROLS

Brake Pedals

Depress brake pedals to stop machine, or to keep engine from overspeeding on down grade.

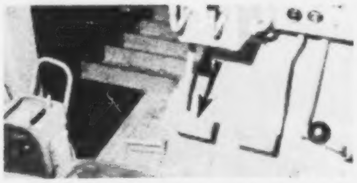
Brake Lock: Earlier Models



1. To ENGAGE brake lock: Depress both brake pedals fully down and push brake lock lever.

2. To DISENGAGE brake lock: Depress both brake pedals fully down and disengage brake lock lever.

Brake Lock: Later Models

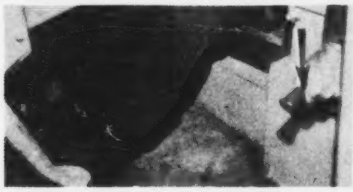


1. To ENGAGE brake lock: Depress left brake pedal firmly. Push the brake lock lever down. Depress right brake pedal firmly.

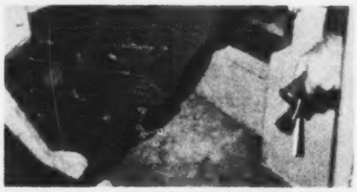
ONLY THE LEFT PEDAL WILL STAY DOWN.

2. To DISENGAGE brake lock: Depress both brake pedals firmly, then pull the brake lock lever up.

Brake Lock — Modular Cab

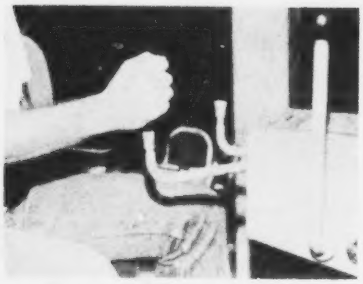


To LOCK parking brake: Depress brake pedals first and then ENGAGE transmission control lever safety lock.

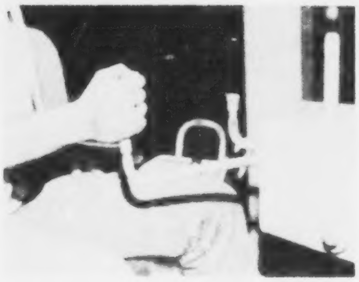


To RELEASE parking brake: Depress brake pedals first and then RELEASE transmission control lever safety lock.

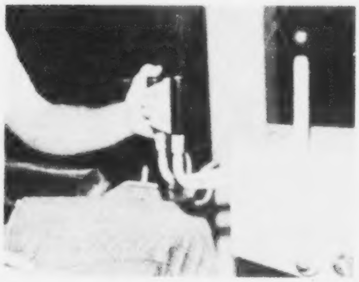
Steering Clutches



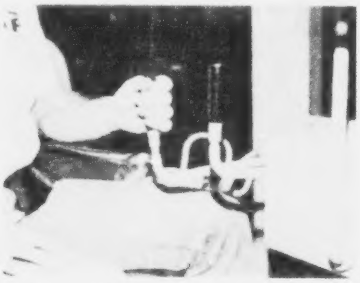
Release right steering clutch by moving lever to detent.



Release right steering clutch and apply right brake by moving lever fully out.

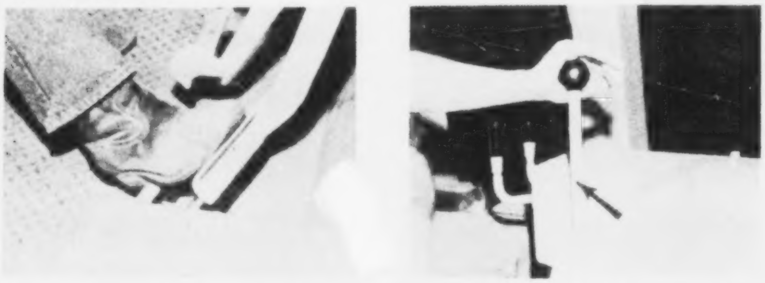


Release left steering clutch by moving lever to detent.



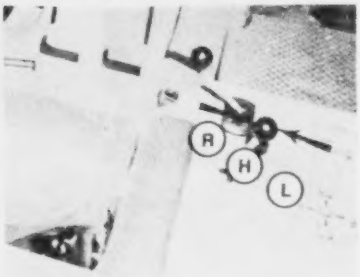
Release left steering clutch and apply left brake by moving lever fully out.

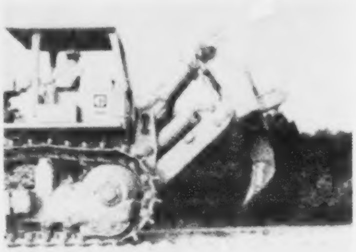
Decelerator



Push decelerator to override governor control and reduce engine speed. Release decelerator to increase engine speed to governor control setting.

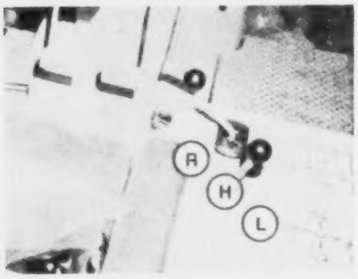
Hydraulic Ripper Height Control –

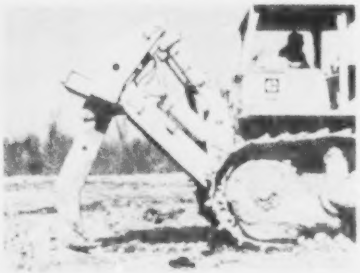




Ⓡ RAISE Ⓗ HOLD Ⓛ LOWER

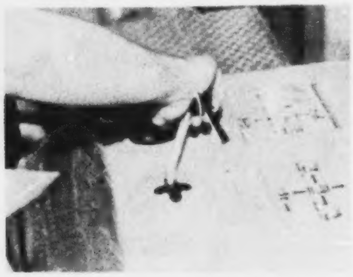
Adjustable Ripper Angle Control – Model D Ripper Only

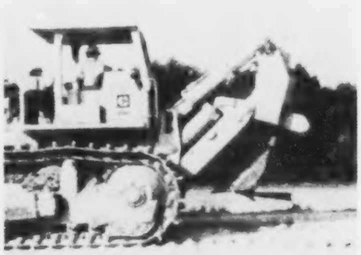




NOTE
RAISE, HOLD and LOWER positions operate the adjustable ripper in the same manner as the hydraulic non-adjustable ripper control.

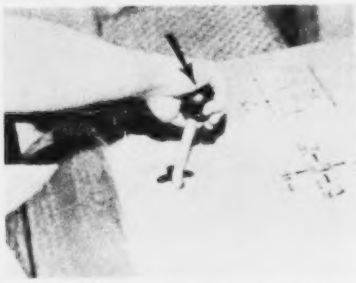
MINIMUM TOOTH ANGLE

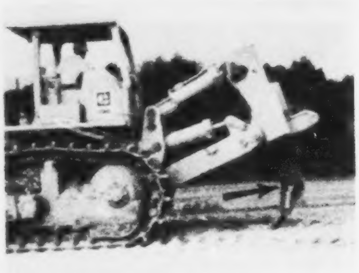




Move ANGLE lever FORWARD.

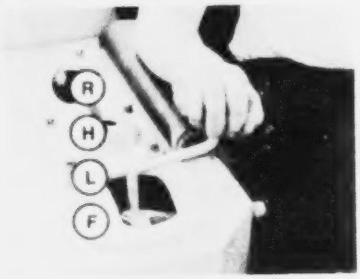
MAXIMUM TOOTH ANGLE

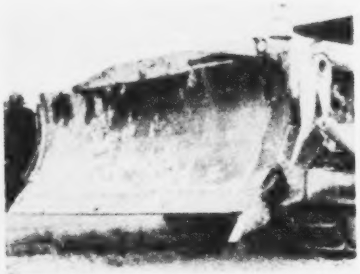




Move ANGLE lever to the REAR.

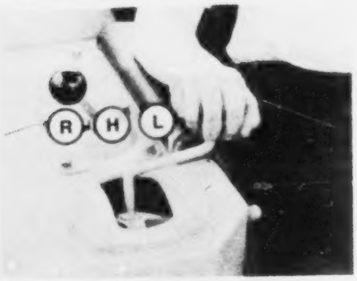
Hydraulic Blade Lift

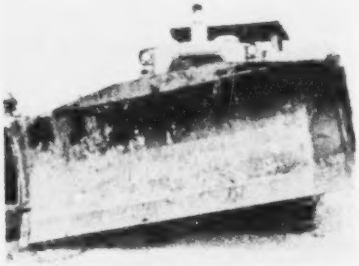




Ⓡ RAISE Ⓗ HOLD Ⓛ LOWER Ⓕ FLOAT

Hydraulic Blade Tilt





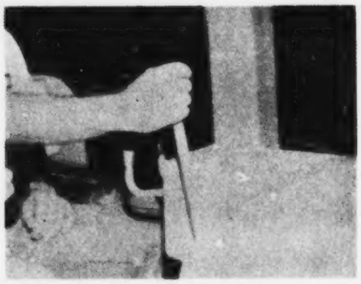
Ⓛ LOWER LEFT SIDE

Ⓡ LOWER RIGHT SIDE

Ⓗ HOLD

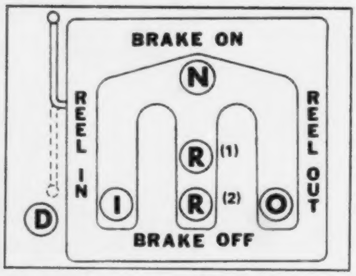
Engine Governor Control

Pull to just past detent to start engine — push fully forward to stop engine.



Pull governor out to obtain desired engine RPM.

Winch Control



BRAKE ON
N
REEL IN
R (1)
R (2)
REEL OUT
D
I
O
BRAKE OFF

Ⓘ REEL IN

Ⓡ(1) BRAKE OFF (RELEASE)

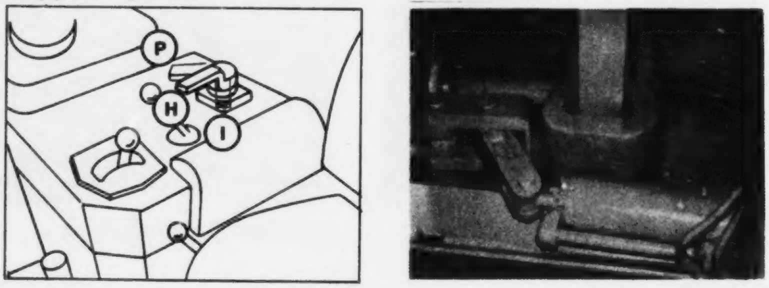
Ⓓ DRUM DISCONNECT

Ⓝ BRAKE ON (NEUTRAL)

Ⓞ REEL OUT

Ⓡ(2) BRAKE OFF DETENT

Ripper Hydraulic Pin Puller — D8K, D9G

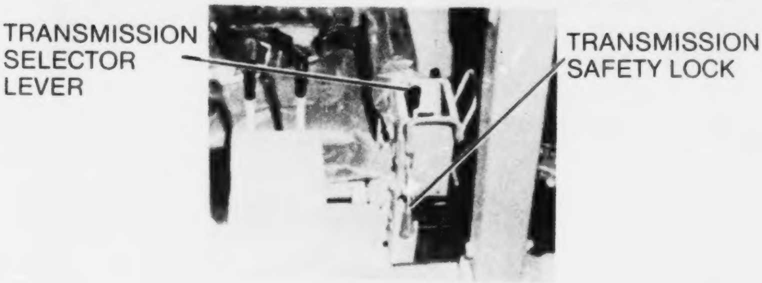


Ⓟ PULL PIN

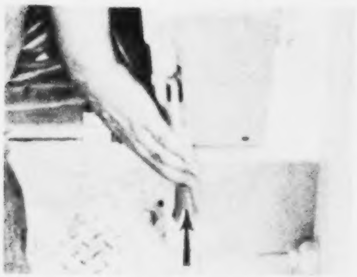
Ⓗ HOLD

Ⓘ INSERT PIN

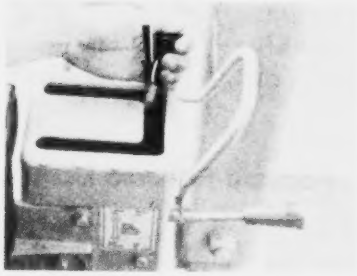
Transmission Controls — Power Shift (D7G, D8K, D9G)


TRANSMISSION SELECTOR LEVER
TRANSMISSION SAFETY LOCK

Transmission Safety Lock

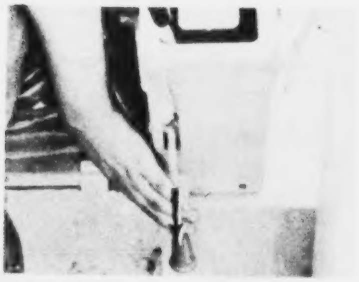


Pull UP on lever to allow shifting of transmission.

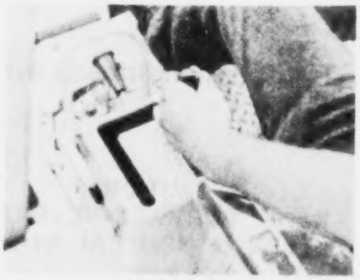


Push transmission lever to NEUTRAL and push safety LOCK — DOWN to lock transmission in neutral.

Transmission Selector Lever

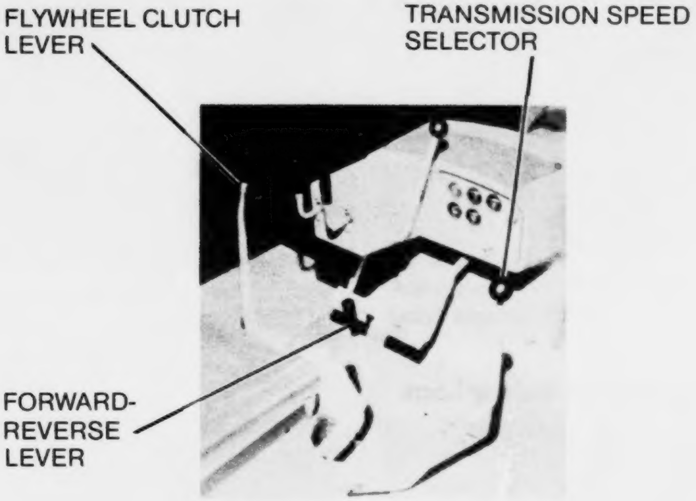


Start engine in NEUTRAL with safety lock ENGAGED.



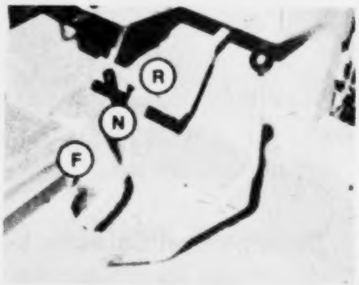
Release safety lock and move selector lever to desired direction and speed.

Transmission Controls — Direct Drive (D7G, D8K only)


FLYWHEEL CLUTCH LEVER
TRANSMISSION SPEED SELECTOR
FORWARD-REVERSE LEVER

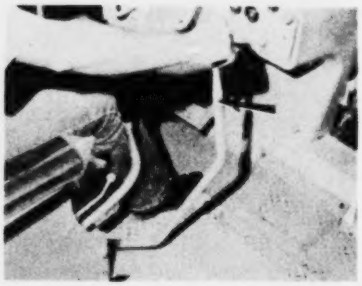
Forward-Reverse Lever

Ⓡ REVERSE DIRECTION
Ⓝ NEUTRAL
Ⓕ FORWARD DIRECTION



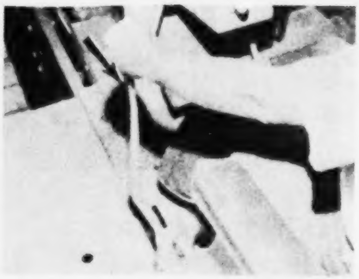
Transmission Speed Lever

CAUTION
Have FORWARD-REVERSE LEVER in NEUTRAL before moving shift lever.

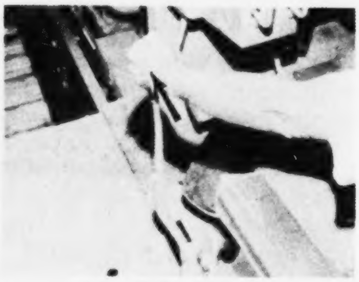


Move lever to desired travel speed.

Flywheel Clutch Lever



Pull lever to the REAR to ENGAGE clutch. Push FORWARD to DISENGAGE clutch.

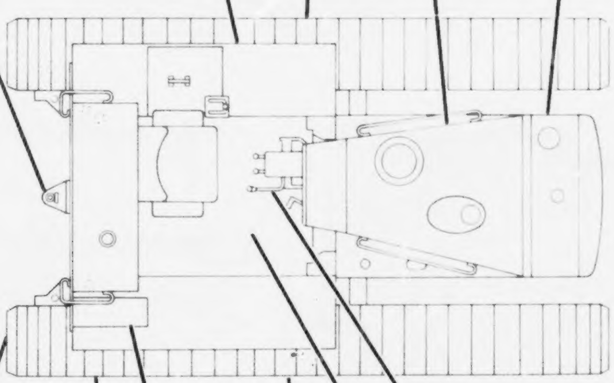


Move lever fully FORWARD to ENGAGE flywheel CLUTCH BRAKE.

BEFORE STARTING

Walk-Around Checks

For your own safety, and maximum service life of the tractor, a thorough walk-around inspection should be made before mounting the machine to start the engine. Inspect around and under machine for such items as loose bolts, trash build-up, lubricant, fuel or coolant leaks, and condition of track and implements.



COVERS AND GUARDS
Inspect for damage, loose or missing bolts.

ROLLERS AND IDLERS
Inspect for wear or leaks.

ENGINE COMPARTMENT
Inspect for oil, coolant and fuel leaks.

TRANSMISSION
Inspect under machine for leaks.

COOLING SYSTEM
Inspect for leaks and trash build-up.

SPROCKETS
Inspect for wear.

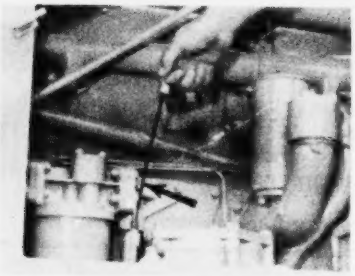
CONTROLS
Inspect for freedom of movement.

FINAL DRIVES
Inspect under machine for leaks.

OPERATOR'S COMPARTMENT
Inspect for cleanliness.

HYDRAULIC SYSTEM
Inspect for leaks — check oil level.

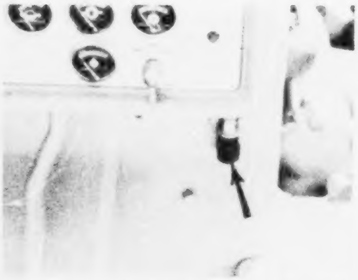
TRACK
Inspect for broken or missing shoes or bolts and proper adjustment.



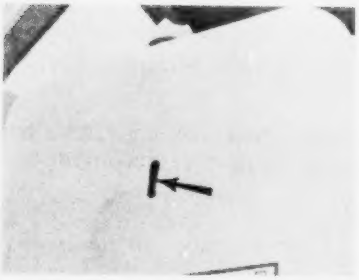
1. Crankcase oil level must be in SAFE STARTING RANGE on ENGINE STOPPED side of dipstick (D9H illustrated).

2. Maintain coolant level within 1/2 inch (1 cm) of bottom of fill pipe.

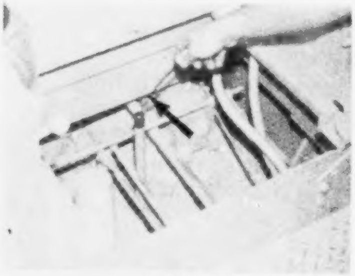
3. Observe diesel fuel level.



4. Observe air cleaner service indicator. Service filter elements if RED indicator is locked in visible position.



5. Observe hydraulic system oil level.



6. Measure transmission oil level.

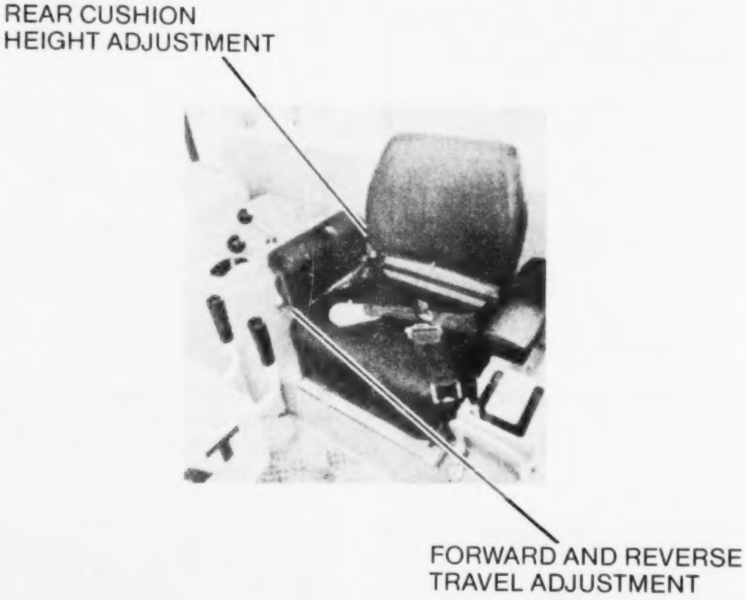
Seat Adjustment — Power Shift and Direct Drive

⚠ WARNING

Seat adjustment should be checked at the beginning of each shift and when operators change.

Always use seat belt when operating machine.

Always check condition of seat belt and connecting brackets.


REAR CUSHION
HEIGHT ADJUSTMENT
FORWARD AND REVERSE
TRAVEL ADJUSTMENT

Adjust seat to allow full brake pedal travel with operator's back against seat back. This will permit application of maximum force on brake pedals.

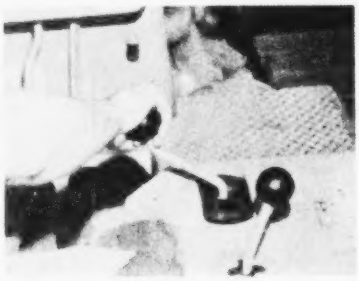
STARTING THE ENGINE

Power Shift

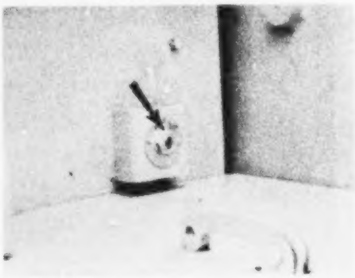
1. Depress both brake pedals and engage brake lock.

2. Move transmission control lever to NEUTRAL.

3. Engage transmission control lever safety lock.



4. Move all equipment controls to HOLD.



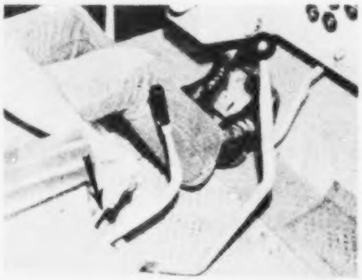
5. Turn disconnect switch on.

6. Move governor control to just past detent position.

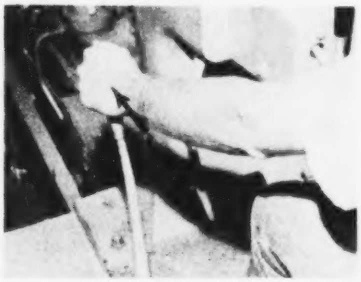
CAUTION

Never turn disconnect switch OFF when engine is running.

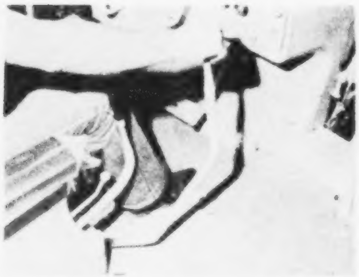
Direct Drive



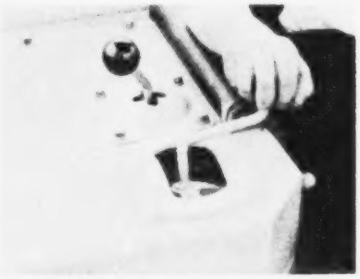
1. Depress brake pedals and engage brake lock.



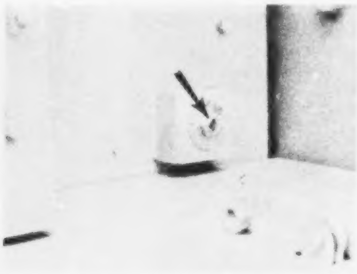
2. Move lever forward to disengage flywheel clutch.



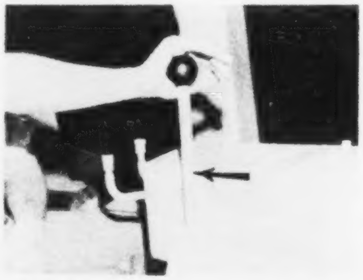
3. Shift gear selector to NEUTRAL. Shift forward-reverse lever to NEUTRAL.



4. Move all equipment controls to HOLD position.



5. Turn disconnect switch ON.

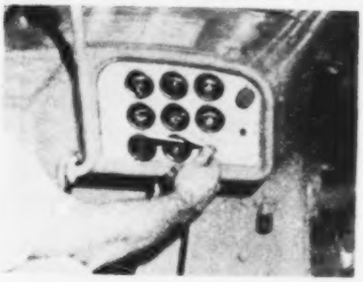


6. Move governor control to just past detent position.

CAUTION

Never turn disconnect switch OFF when engine is running.

Above 60°F (16°C)

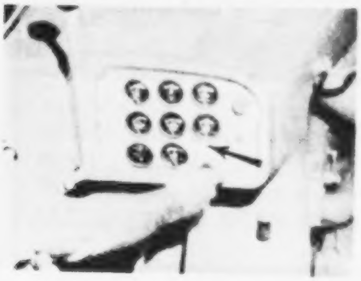


7. Push in and turn HEAT-START switch to START.

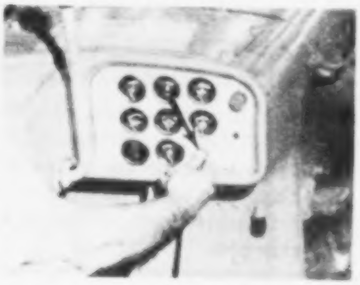
8. Release switch as soon as engine starts.

Below 60°F (16°C)

Do items 1 through 6, under "Above 60°F (16°C)".



1. Push in and turn HEAT-START switch to HEAT for indicated time (see Starting Aid Chart).



2. Push in and turn HEAT-START switch to START.(1)

3. Release switch as soon as engine starts.

4. When engine starts it may be necessary to return HEAT-START switch to HEAT until engine runs smoothly.

CAUTION

Never switch to HEAT when engine is warm and running.

STARTING AID CHART	
STARTING TEMPERATURE	GLOW PLUG HEAT TIME
ABOVE 60°F (16°C)	NO
60°F (16°C) TO 32°F (0°C)	1 MINUTE
32°F (0°C) TO 0°F (−18°C)	2 MINUTES
BELOW 0°F (−18°C)(2)	3 MINUTES

(1)If engine does not start after 10 seconds, switch to HEAT for 30 seconds then start. If engine again does not start, let starter cool 2 minutes then repeat starting procedure.

(2)Heating of coolant and crankcase oil, use of starting fluid aid and/or use of extra battery capacity may be required.

Starting With Boost

⚠ WARNING

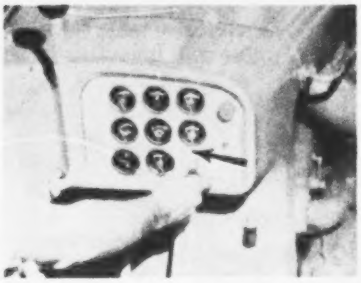
Attach ground cable last, and remove first, to prevent sparks from occurring near the battery which could cause battery vapors to explode. Attach ground cable from booster battery to frame of machine to be started at a point away from, and below, the battery on the machine to be started.

CAUTION

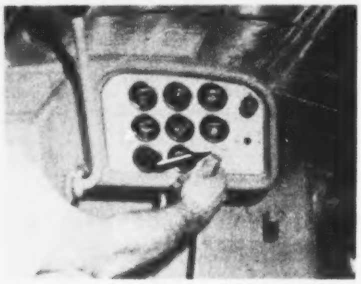
When using jumper cables, be sure to connect in parallel: Negative (−) to negative (−) and positive (+) to positive (+).

Do not permit cable ends to contact one another, or touch machine (except when grounding cable).

Do items 1 through 6, under "Above 60°F (16°C)".



1. Push in and turn HEAT-START switch to HEAT for indicated time (see Starting Aid Chart).



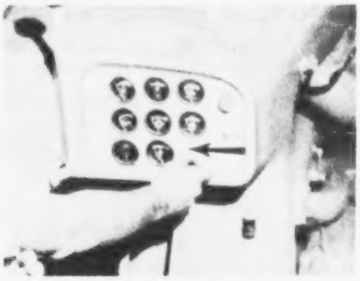
2. Push in and turn HEAT-START switch to START . . .

⚠ WARNING

Use starting fluid sparingly. Follow manufacturer's instructions carefully.

Do not store starting fluid in operator's compartment.

3. . . . and discharge starting aid capsule or spray starting fluid sparingly into precleaner while cranking.



4. When engine starts it may be necessary to return HEAT-START switch to HEAT until engine runs smoothly.

CAUTION

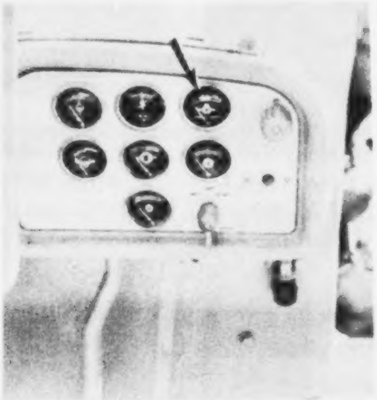
If engine again does not start, let starter cool 2 minutes, then repeat starting procedure.

Do not turn switch to HEAT when engine is hot and running.

AFTER STARTING

CAUTION

Keep engine speed low until oil pressure registers, if oil pressure does not register within 10 seconds, stop engine and investigate.



Observe air cleaner service indicator. Push release button. If RED piston remains in, or returns to, the visible position, have air cleaner serviced.

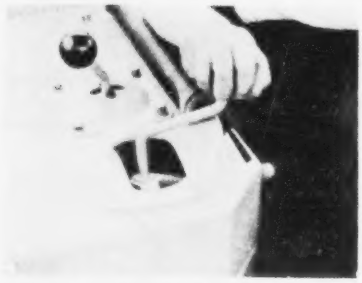
Operate engine under light load for 5 minutes.

Observe gauges frequently during operation. All gauges must indicate in the NORMAL operating range. The ammeter is normal when the indicator is at or on the + side of zero.

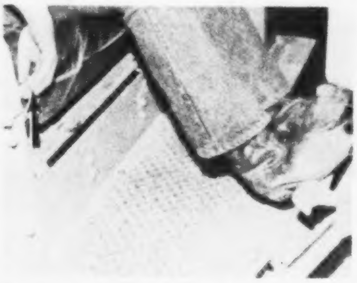
If tractor is equipped with WATER PRESSURE and WATER TEMPERATURE gauges, both gauges should register in the same color ranges. Do not operate when TEMPERATURE gauge indicator is BEYOND color range indicated by PRESSURE gauge. However, the tractor may be operated if PRESSURE gauge indicator is BEYOND color range indicated by TEMPERATURE gauge.

MOVING THE TRACTOR

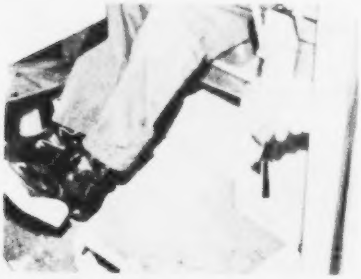
Power Shift



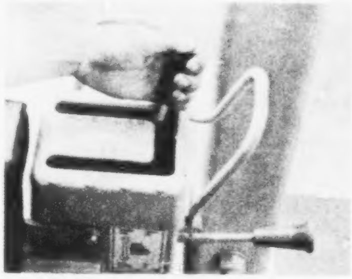
1. Raise lowered equipment high enough to clear obstructions.



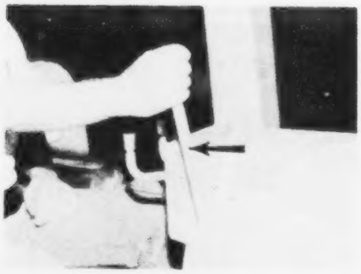
2. Depress both brake pedals and release brake lock.



3. Release transmission safety lock.

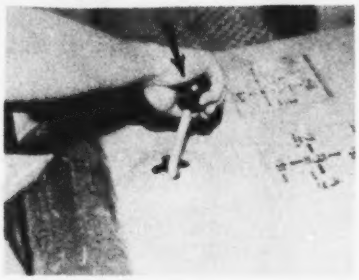


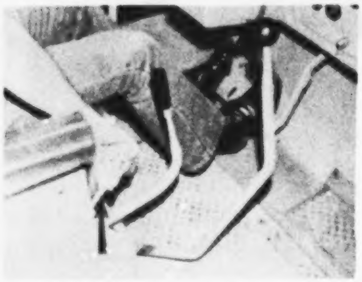
4. Move transmission control lever to desired direction and gear position.

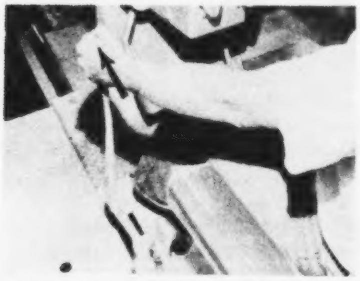


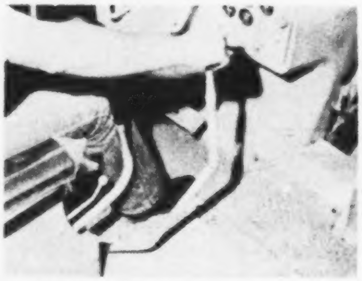
5. Move governor control lever to desired engine speed.

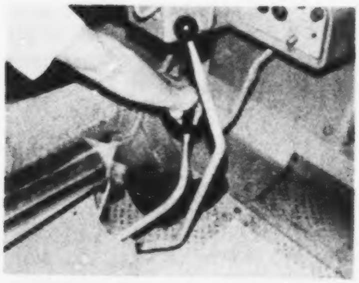
Direct Drive

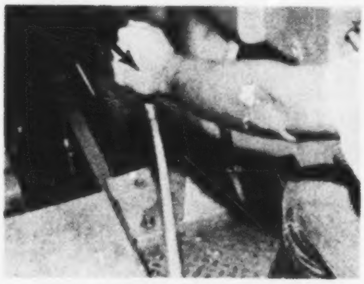

1. Raise lowered equipment high enough to clear obstructions.


2. Depress brake pedals and release brake lock.


3. Move flywheel clutch lever forward to apply clutch brake.


4. Move gear selector to desired gear position.


5. Move forward-reverse lever to desired travel direction.

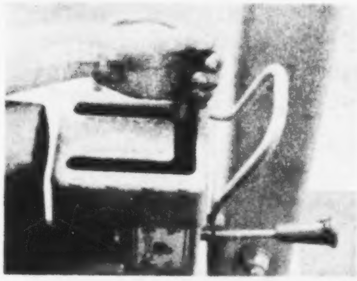

6. Pull flywheel clutch lever back to engage clutch.

To Change Direction — Powershift

NOTE
Gear and directional shifts at full engine speed are permissible. However, for operator comfort and maximum service life of power train components, decelerating and/or braking is recommended.

1. Decrease engine speed by pushing governor control or pushing decelerator.

2. Push both brake pedals.



3. Move transmission control lever to desired travel direction gear.

4. Release brake pedals.

5. Increase engine speed by pulling governor control out, or releasing decelerator.

NOTE
Do not use brake pedals as foot rests.

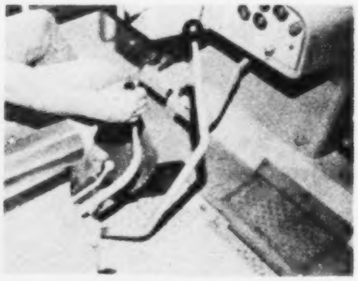
6. Move governor control or decelerator to obtain desired engine speed.

To Change Direction — Direct Drive and Special Application

1. Reduce engine speed and depress brake pedals to reduce machine travel speed. Disengage the flywheel clutch.

2. Depress both brake pedals to stop tractor. Push clutch lever forward to apply clutch brake.

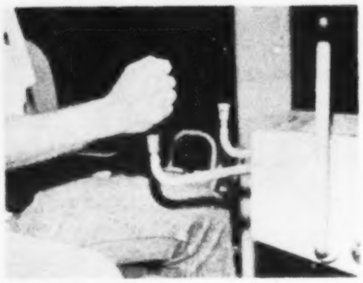
CAUTION
Do not use brake pedals as foot rests.



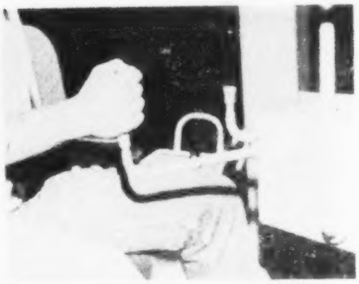
3. Move forward-reverse lever to desired travel direction, and change gear lever position.

4. Release brakes and engage flywheel clutch.

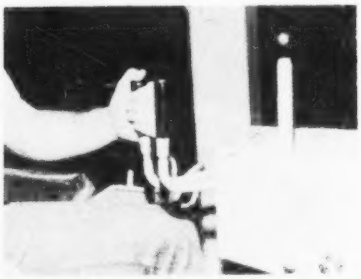
Normal Steering



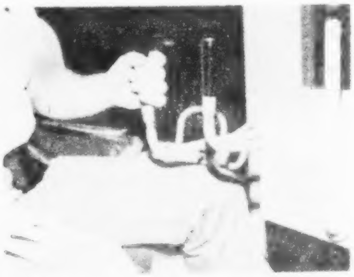
Gradual RIGHT turn – Release right steering clutch by moving lever to detent.



Sharp RIGHT turn – Release right steering clutch and apply right brake by moving lever fully out.



Gradual LEFT turn – Release left steering clutch by moving lever to detent.



Sharp LEFT turn – Release left steering clutch and apply left brake by moving lever fully out.

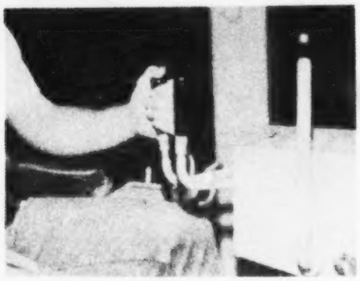
⚠ WARNING

Keep tractor under control at all times. DO NOT NEUTRALIZE TRANSMISSION or FORWARD-REVERSE LEVER, or DISENGAGE FLYWHEEL CLUTCH to allow machine to coast.

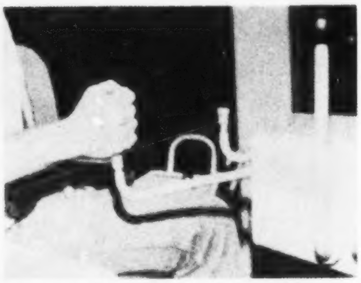
Select gear range necessary before starting downgrade. DO NOT change gears while going downhill.

DO NOT ALLOW TRACTOR TO COAST DOWNHILL.

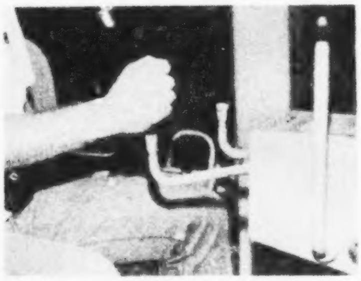
Steering on Steep Downgrade



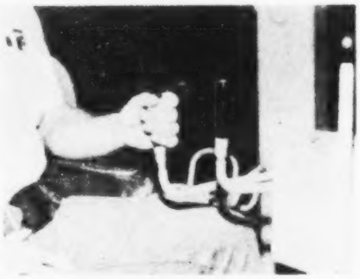
Gradual RIGHT turn — Release left steering clutch by moving lever to detent.



Sharp RIGHT turn — Release right steering clutch and apply right brake by moving lever fully out.



Gradual LEFT turn — Release right steering clutch by moving lever to detent.

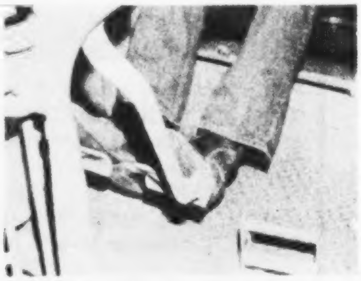


Sharp LEFT turn — Release left steering clutch and apply left brake by moving lever fully out.

⚠ **WARNING**

When load is pushing tractor, put gear selector in FIRST speed before starting downhill.

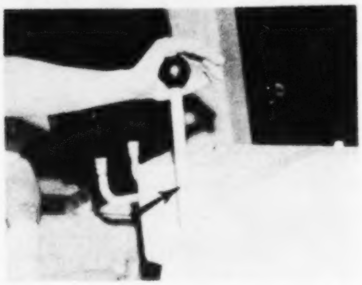
DO NOT RELEASE CLUTCH OR SHIFT TRANSMISSION WHILE MOVING.



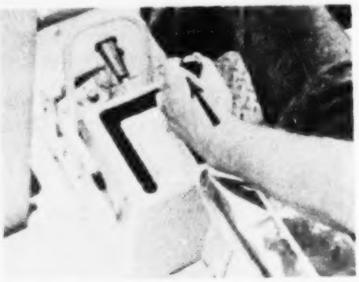
If engine starts to overspeed, depress both brake pedals.

PARKING THE TRACTOR

Stopping Tractor — Power Shift



1. Stop tractor on level ground, and reduce engine speed.

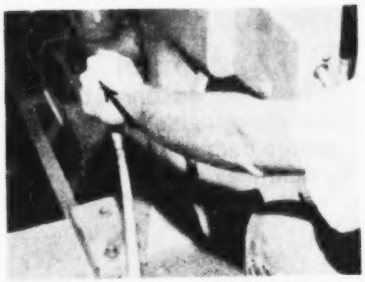


2. Move transmission control lever to NEUTRAL.

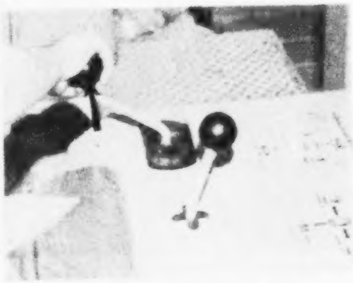
3. Engage transmission control safety lock.

4. Apply brake pedals and engage brake lock. Lower all equipment.

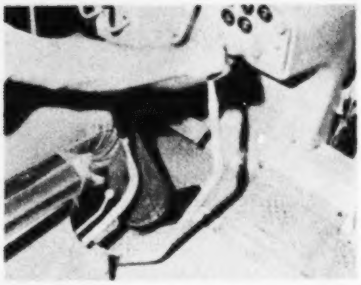
Stopping Tractor — Direct Drive



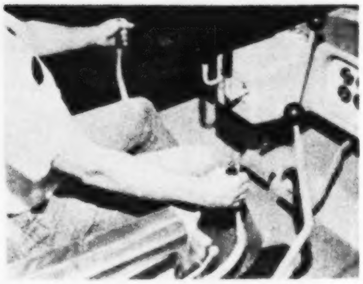
1. Stop tractor on level ground: reduce engine speed and depress brake pedals to reduce machine speed. Disengage the flywheel clutch.



2. Apply brake pedals and engage brake lock. Lower all equipment.



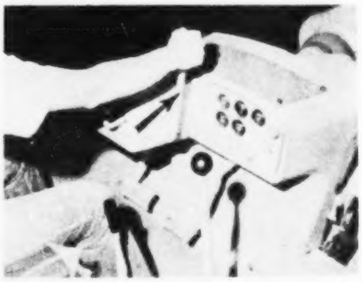
3. Move gear selector to NEUTRAL.



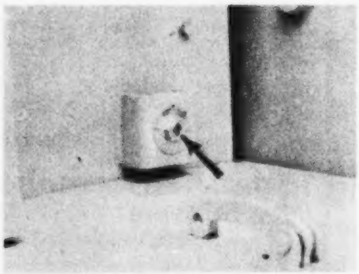
4. Move forward-reverse lever to NEUTRAL and engage flywheel clutch.

Stopping the Engine

With machine stopped, operate engine at low idle for 5 minutes and then stop engine.



1. Push governor control past detent to shut off engine.

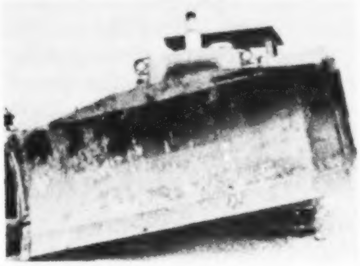


2. Turn disconnect switch OFF and remove key.

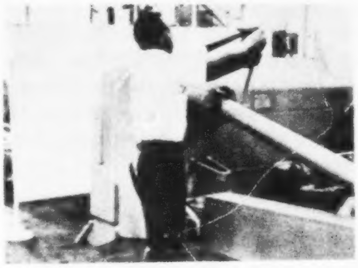
CAUTION
Never turn disconnect key to OFF while engine is running, or serious damage to the electric system may result.

OPERATING ADJUSTMENTS

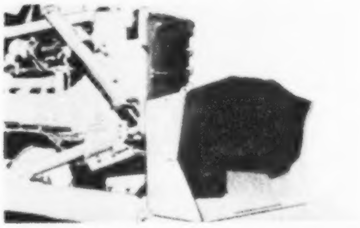
Bulldozer Blade Tilt and Tip



To tilt blade:
1. Retract hydraulic cylinder for blade to be low on right side.
2. Extend hydraulic cylinder for blade to be high on right side.



3. If additional tilt is required the brace may be adjusted. Shorten brace to make left side of blade lower and lengthen brace to make left side of blade higher.

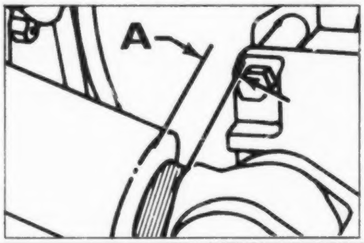


To tip blade:
1. Lengthen brace and extend hydraulic cylinder to tip blade forward.

2. Shorten brace and hydraulic cylinder to tip blade back.

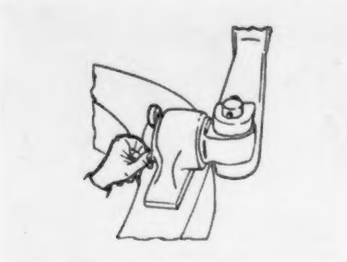
CAUTION

Do not exceed "MAXIMUM DISTANCE AT Ⓐ" shown in chart below.



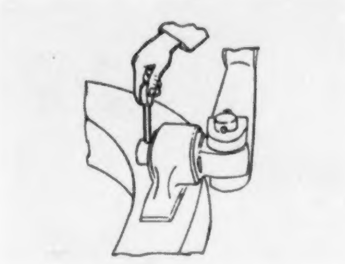
MODEL	MAXIMUM DISTANCE AT Ⓐ
7A	3" (75 mm)
7S, 7U	4.25" (108 mm)
8A, 8S, 8U, 9A	4.9" (124 mm)
9S, 9U	4.6" (117 mm)

Bulldozer Blade Angling

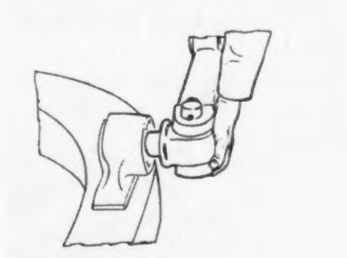


To angle blade...

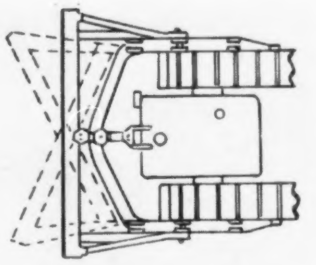
1. Remove lock pin from retainer pin. One each side.



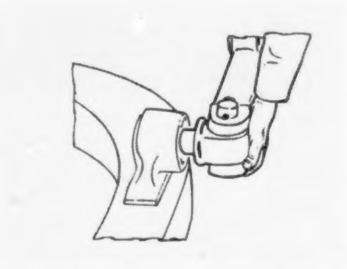
2. Remove coupling retainer pins.



3. Pull coupling pin out of housing.



4. Position blade at desired angle.



5. Install coupling pins in new positions.

6. Install coupling retainer pins.

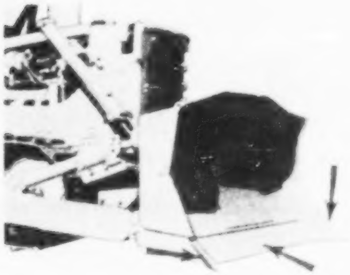
7. Install lock pins.

Track

CAUTION

If track is too tight, wear of track components is accelerated. If track appears too tight have track adjusted. See the proper LUBRICATION and MAINTENANCE GUIDE for adjustment procedure.

Cutting Edges and End Bits



Have cutting edges and end bits replaced, or reversed, before wear on the dozer blade base occurs.

CAUTION

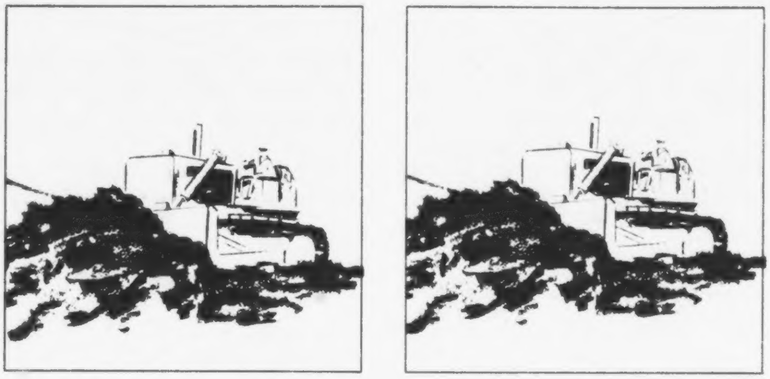
Tracks should be adjusted under the same conditions that the machine will be used. That is, if packing conditions prevail on the job the tracks should be adjusted with the packing present.

Ripper Tips

Have ripper tips replaced before wear on the ripper shank occurs.

OPERATING TECHNIQUES

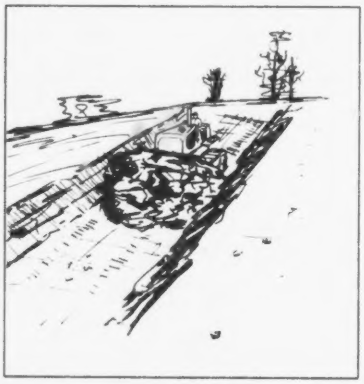
Dozing



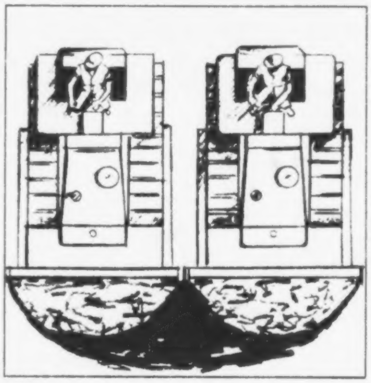
Straight Dozing: If the blade digs in and the rear of the tractor rises, raise blade to continue even cut. When moving a heavy load causes travel speed to drop, shift to a lower gear and/or raise the blade up slightly.

NOTE

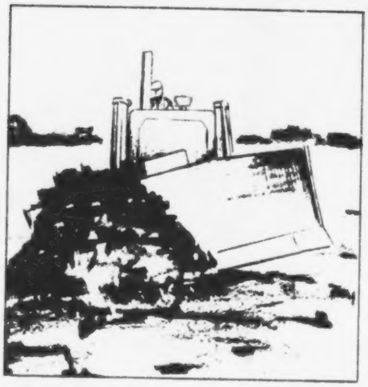
When doing finishing or leveling work, a full blade handles easier than a partially loaded blade.



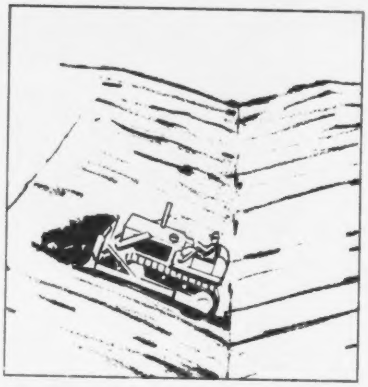
Slot Dozing: This allows larger loads to be carried in front of the blade. It is used in stockpiling and high production bulldozing.



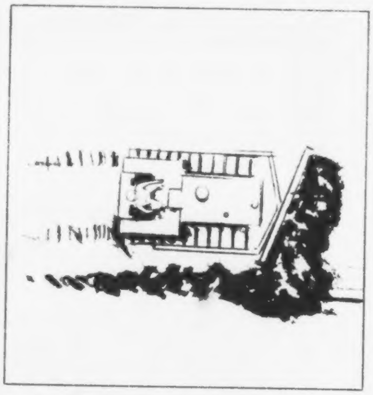
Side-by-side Dozing: Use when moving large quantities of loose material. Keep blades close together and tractors parallel.



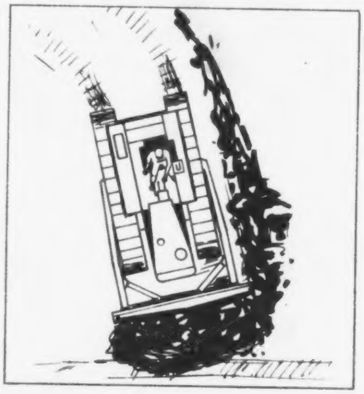
Tilt Dozer Ditching: Tilt blade and work with low side in ditch center. Level blade when required depth and slope are reached.



Straight Dozer Ditching: Tilt blade to cut shallow "V" ditches. For larger ditches, doze at right angles to center line of ditch. When desired depth is reached, doze length of ditch to smooth sides and bottom.

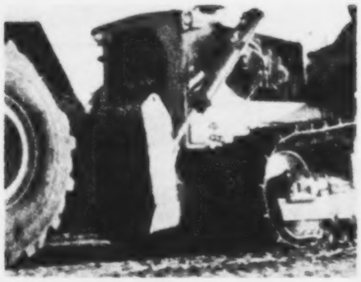


Angle Dozer Backfilling: Travel parallel to ditch.

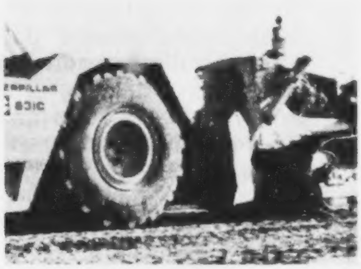


Straight Dozer Backfilling: Push at a 90° angle to ditch.

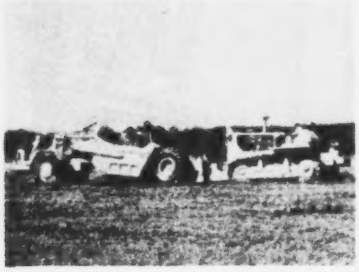
Push Loading

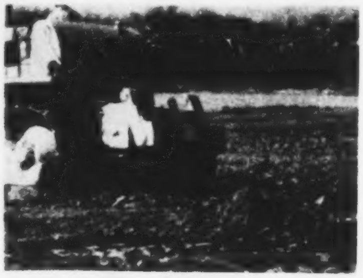

1. Position bulldozer cutting edge slightly above ground level.

2. Tractor should not be traveling more than 3 miles per hour faster than scraper when contact is made.

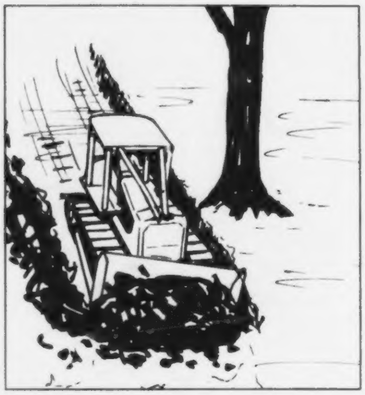

3. Contact push block squarely. Don't allow blade or push cup to contact scraper tires.

4. Do not lift rear of scraper off the ground.

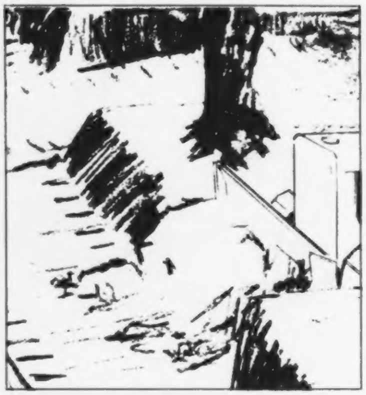

5. Upshift tractor when cut is complete to help scraper get moving.


6. When tandem pushing, the front tractor must be equipped with a case mounted tandem push block.

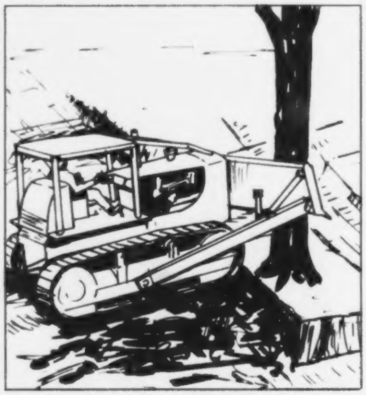
Land Clearing



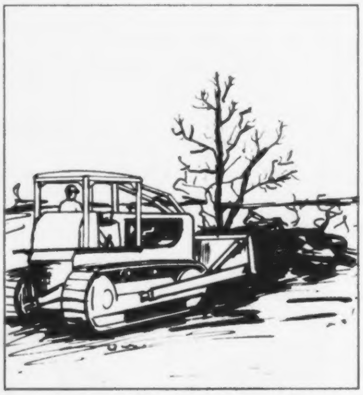
Tree Removal: 1. Remove any dead limbs. Cut roots on side opposite direction of fall.



2. Cut roots on sides parallel to direction of fall.



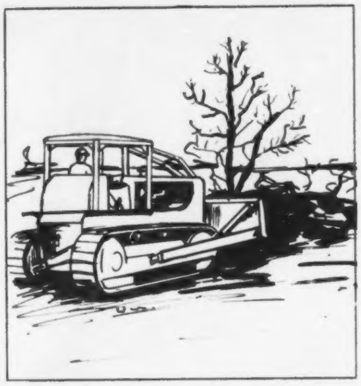
3. Ease into tree. Push in direction of fall with blade high. Build earth ramp if higher contact is needed.



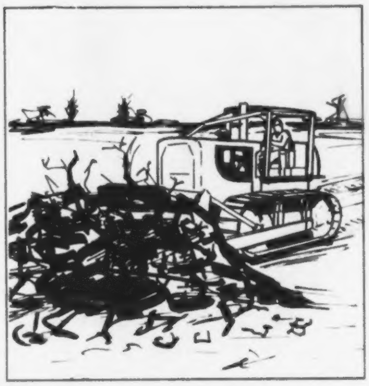
4. Do not drive onto stump while tree is falling.

⚠ WARNING

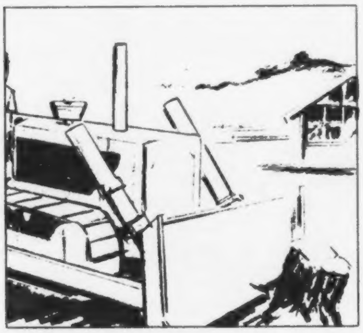
Back away immediately when tree starts to fall.



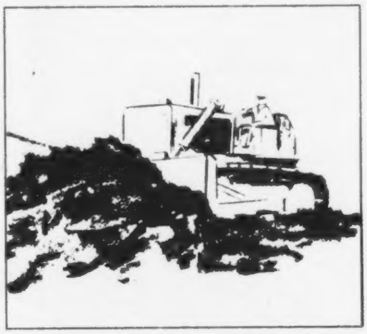
Large Brush and Medium Size Trees: Contact tree 12 to 16 inches (300 to 400 mm) above ground. Move forward while lifting blade.



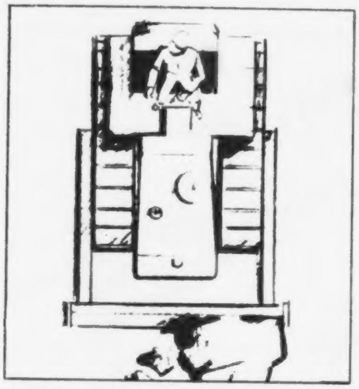
Brush Clearing: Lower blade a few inches into the ground and move forward. Lift blade when brush is out to loosen earth from roots.



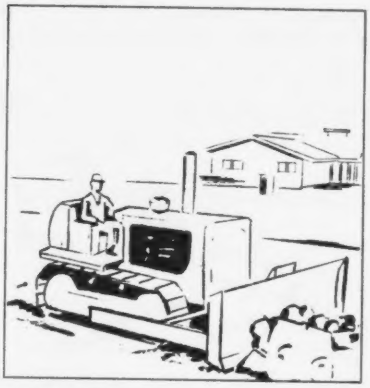
Stump Removal: Lift blade while pushing.



Side Hill Cut: Start cut downgrade if possible. Slope to inside of cut. Doze bench wide enough for machines that will follow.



Straight Dozer: Contact rock at one side of blade.

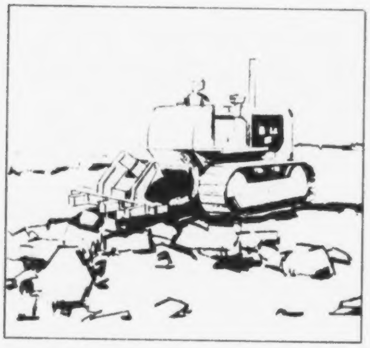


Angle Dozer: Contact rock at center of blade.

⚠ WARNING

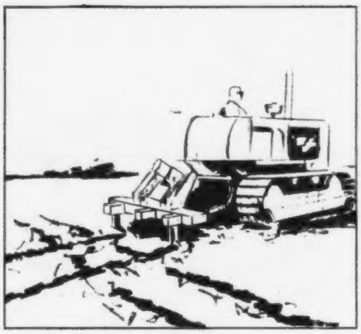
Use extra caution when crossing side hills, ridges, logs and ditches.

Ripping

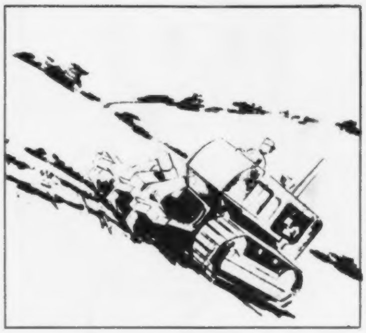


Use FIRST speed for most ripping operations. It is better to use additional shanks, where practical, rather than to increase speed.

Always use center shank when ripping with one shank. If material breaks up satisfactorily, more shanks may be used.



Cross rip only when necessary.



When ripping for scraper loading, rip in same direction that scrapers will load.

NOTE
Rip downhill whenever possible.

CAUTION

Do not turn or back tractor while shanks are in the ground. Twisting strain on the shanks and tips may cause failure.

Inspect ripper tips frequently, for excessive wear.

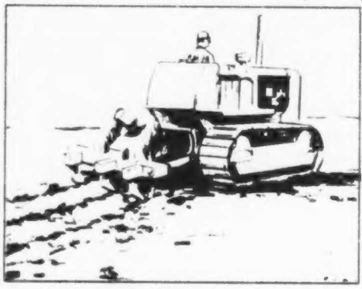
Ripper Operating Hints:

In most cases it is desirable to rip as deep as possible. Sometimes it is better to rip at partial depth and remove the material in its natural layers.

Keep several inches of material on top of the unripped formation to cushion the machine and provide traction.

When final material size must be relatively small, close spacing of passes is recommended.

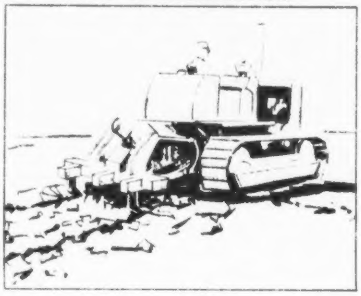
Packed Soil, Hard Pan, Clay, Shale or Cemented Gravel



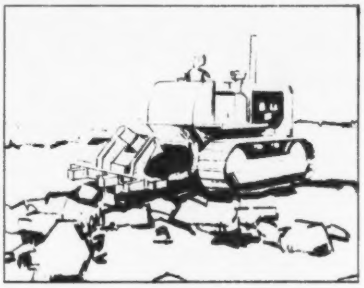
Three shanks work well in these materials. Use as many shanks as possible to break material to desired size, without stalling or hanging up the machine.

Rock with Fractures, Faults and Planes of Weakness

Use two shanks where rock breaks out in small pieces, and the machine can handle the job easily. When machine begins to stall or tracks spin, use only the center shank.



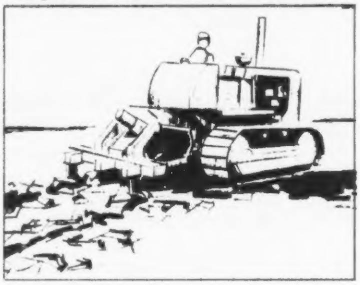
Solid Rock, Granite or Hard-to-Rip Material



Use one shank in tough-to-rip material or material that tends to break out in large slabs or pieces.

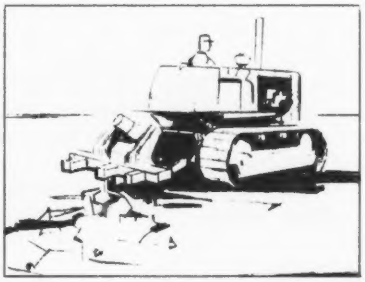
Always use center shank when one-shank ripping.

Asphalt Road Surfaces



Raise ripper shanks to lift out and break material.

Concrete Road Surfaces

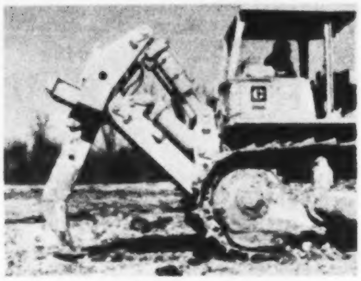


Use a single ripper shank. Ripper is especially effective in severing reinforcing rods or mesh.

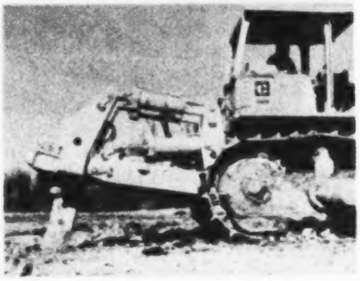
Adjustable Ripper

All other ripping information in this guide also applies to the adjustable ripper.

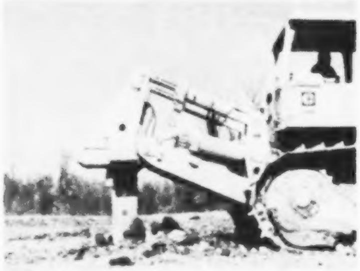
The angle of the shank can be varied, while ripping, to achieve maximum performance throughout each ripping pass.



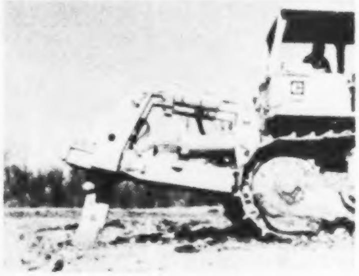
To insert the ripper into the material to be ripped, adjust the angle of the shank beyond vertical position. This will give the correct tip angle for easy entry into the material. Angle will differ depending upon material being ripped.



Lower ripper into the material while moving forward. When desired ripping depth is reached, move the shank forward to obtain the correct angle for best performance. This is usually between vertical and forward positions of shank.



Move the ripper shank to the forward or "shank in" position when prying out lodged material.



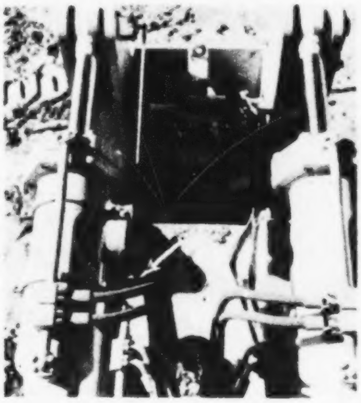
Move the ripper to the rear or "shank out" position when additional clearance between ripper and track is necessary.

Shallow ripping is recommended when material is to be removed by a scraper, loader, or dozer.

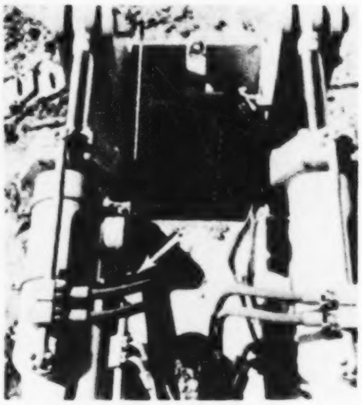
Deep ripping is recommended when material is to be removed by an excavator.

Use a longer shank to provide more clearance between the ground and the beam. The longer shank may be used for shallow ripping as well as deep ripping.

Shank Angle Indicator



When desired ripping angle is achieved, note location of indicator.



To reposition shank to desired angle, move shank until shank angle indicator is at original position.

Winch Operation

⚠ WARNING

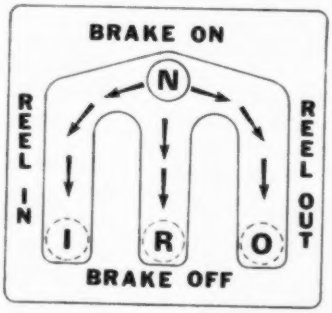
Make certain personnel are clear of cable when there is a load on the cable. Cable can break and cause personal injury.

CAUTION

Always winch with cable in as straight a line as possible behind tractor.

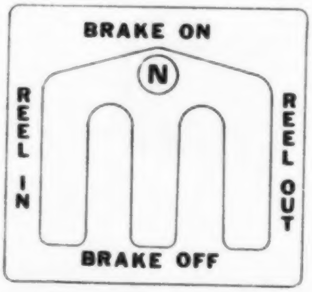
For maximum service life of winch, engage winch at lowest practical engine speed. Heavy line loads will require winch engagements at higher engine speeds than with lighter loads.

Line speed is controlled by the engine speed.

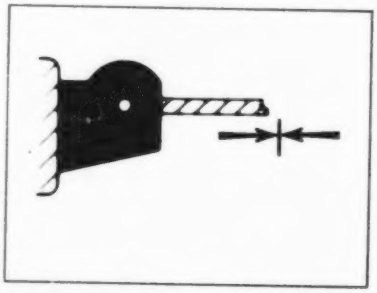

BRAKE ON
N
REEL IN
REEL OUT
I
R
O
BRAKE OFF

WINCH CONTROL CONSOLE

Ⓝ BRAKE ON (NEUTRAL)


BRAKE ON
N
REEL IN
REEL OUT
BRAKE OFF

BRAKE ON (NEUTRAL) – Towing, holding load or when winch is not in use.

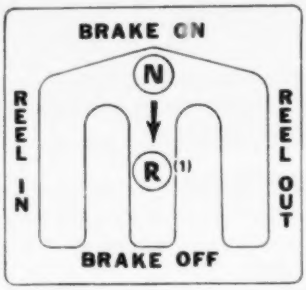


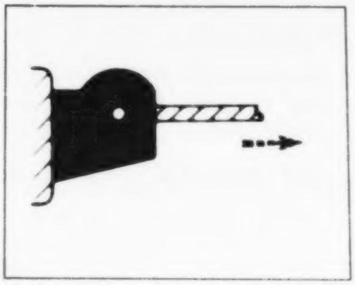
Cable will not move.

⚠ WARNING

Exercise care with suspended loads. If engine speed is too low the weight of the load may cause it to drop, even though the winch is in REEL IN position.

Ⓡ(1) BRAKE OFF (RELEASE)


BRAKE ON
REEL IN
N
R(1)
REEL OUT
BRAKE OFF



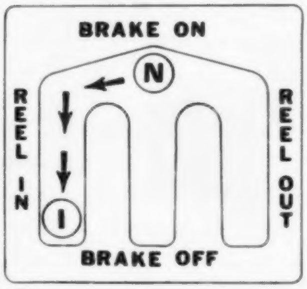
Cable will move out with load on cable.

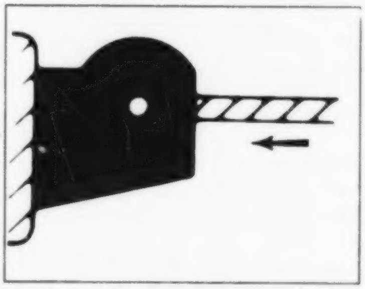
BRAKE OFF (RELEASE) – Moving tractor away from heavy load, or lowering a load by its own weight. When released, the lever will return to neutral position.

CAUTION

Do not leave in BRAKE OFF for extended periods. When moving away from a load, operate tractor in low gear to prevent overspeeding of winch components.

Ⓘ REEL IN

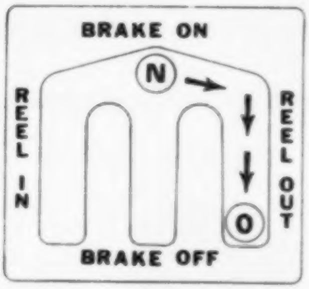

BRAKE ON
REEL IN
N
I
REEL OUT
BRAKE OFF

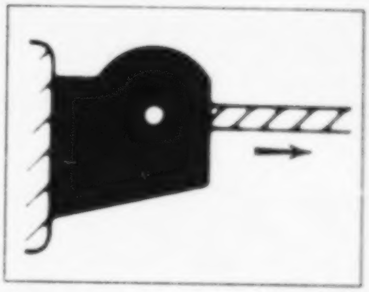


Cable will move toward the winch under power.

REEL IN – Pull load toward machine. When released, the lever will return to neutral position.

Ⓞ REEL OUT





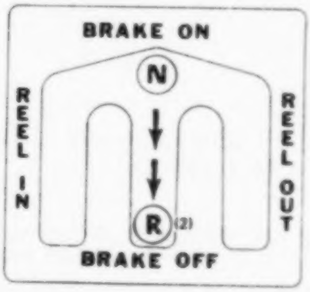
REEL OUT – Lower light load with power, or moving away from load in first gear. When released, the lever will return to neutral position.

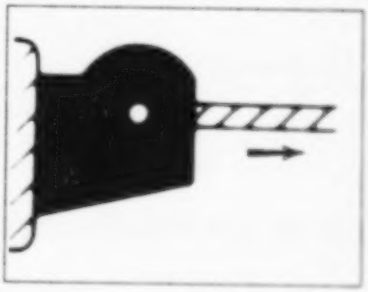
Drum will turn in reverse direction to unspool cable under power.

NOTE

To reel in or out slowly, engage and disengage clutch, and/or decelerate and accelerate as necessary.

Ⓡ(2) BRAKE OFF DETENT





BRAKE OFF DETENT – Moving tractor away from heavy load, or lowering a load by its own weight. Operator must manually remove the lever from detent position.

Cable will move out with load on cable.

NOTE

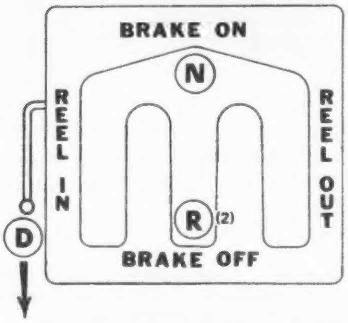
Usually enough tension will be maintained with the lever in Ⓡ(2). However, some braking may be required to hold a load on a slope, with the tractor moving forward. Use only as necessary to maintain minimum line tension.

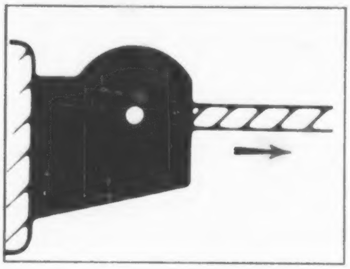
Ⓓ DRUM DISCONNECT

CAUTION

Winch control lever must be in BRAKE OFF position to disconnect cable drum from drive line.

DO NOT reengage DRUM DISCONNECT while drum is running.





DRUM DISCONNECT — Operator can unreel cable by hand. Operator must manually disengage drum disconnect.

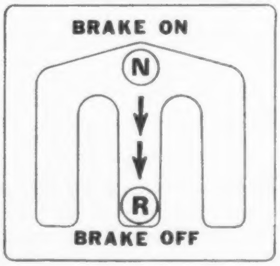
Cable can be pulled away from the winch by hand.

INCHING OUT

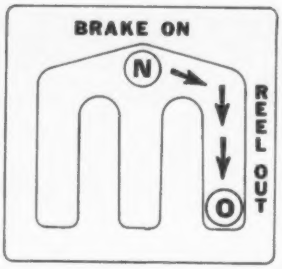
CAUTION

Inch loads with engine speed low and tractor stationary. Do not operate for extended periods of time while INCHING.

Inching (Fine Control Operation)



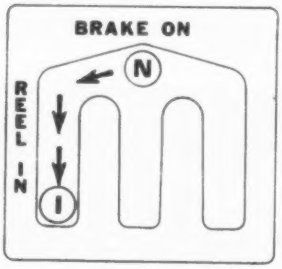
1. Move lever slowly towards BRAKE OFF position until load starts to move. For precise lowering, move lever slightly to engaged or disengaged position as required.
2. When Load Is Not Heavy Enough To Lower Itself In The BRAKE OFF Position.



A. Direct Drive:
Disengage flywheel clutch. Position lever in the REEL OUT slot so load will move when flywheel clutch is slowly engaged.

B. Power Shift:
Move the lever slowly towards the fully engaged REEL OUT position until load starts to move.

INCHING IN:



Direct Drive:
Disengage flywheel clutch. Position lever in the REEL IN slot so load will move when flywheel clutch is slowly engaged. Adjust engine speed as necessary to move load.

Power Shift:
Move lever slowly towards the fully engaged REEL IN position until load starts to move. Increase engine speed if necessary to raise load.

NOTE

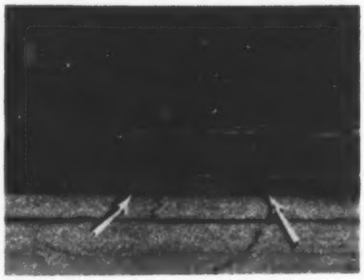
Engine or torque converter may stall if line load and/or engine load is too high when engaged.

TRANSPORTATION HINTS

⚠ WARNING

CHECK TRAVEL ROUTE FOR OVERPASS CLEARANCES. MAKE SURE THERE WILL BE ADEQUATE CLEARANCE IF VEHICLE BEING TRANSPORTED IS EQUIPPED WITH ROPS, CAB OR CANOPY.

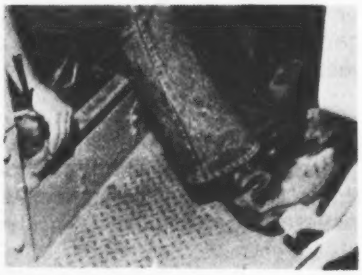
Always block trailer or rail car wheels before loading tractor.



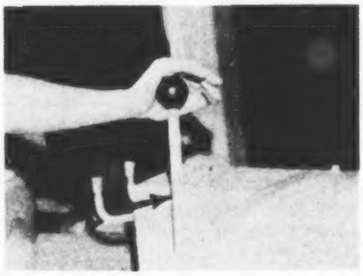
Install tie-downs at several locations, and block tracks, front and rear.

CAUTION

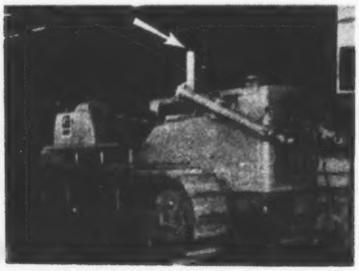
Remove ice, snow or other slippery material from shipping vehicle and loading dock.



Apply brake lock and place transmission in NEUTRAL.



Shut off engine and remove disconnect switch key.

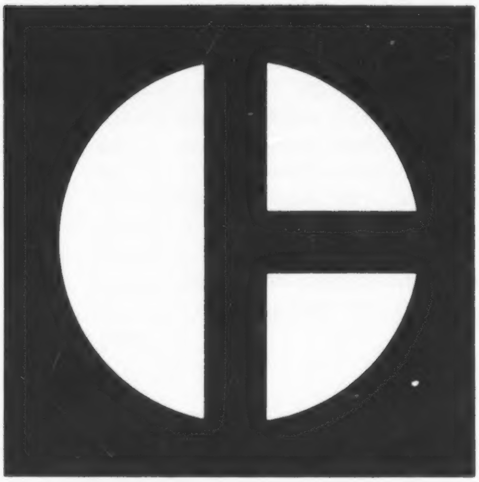


Cover engine exhaust opening to prevent turbocharger windmilling in transit.

Check state and local laws governing weight, width and length or load.

CHAPTER 2
ENGINE

FORM NO. SENR7004



SPECIFICATIONS

FOR

D342 VEHICULAR ENGINE

SERIAL NUMBERS
17S1-UP
50V1-UP

INTRODUCTION

The specifications in this book are given on the basis of information that was current at the time the book was written. These specifications give the torques, operating pressures, measurements of new parts and other items. When the word "permissible" is used in the description, the specification value given is the "maximum or minimum" normally permitted before adjustment, repair and/or new parts are needed. Make a comparison of the measurements of a worn part with the specifications of a new part to find the amount of wear. The wear factor is not the only basis for the replacement of parts. The expected service life of the worn part is a factor. A part that is worn can be safe to use if an estimate of the remainder of its service life is good. When a disassembly is made for the purpose of reconditioning, the recommendation is the replacement of parts not completely worn out if a short service life is expected. 77200

This D342 Vehicular Engine is used in: D8 Tractor, Serial Numbers 66V, 76V, 77V; 583 Pipelayer, Serial Number 78V.

D342 VEHICULAR ENGINE

Number of Cylinders	6
Bore and Stroke	5 3/4" x 8"
Firing Order	1, 5, 3, 6, 2, 4

NOTE: For System Operation and Testing and Adjusting, make reference to the D342 VEHICULAR ENGINE, Form No. SENR7003.

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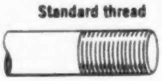
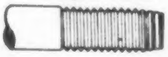
GENERAL TIGHTENING TORQUE FOR BOLTS, NUTS AND TAPERLOCK STUDS

The following charts give the standard torque values for bolts, nuts and taperlock studs of SAE Grade 5 or better quality. Exceptions are given in the Specifications.

THREAD DIAMETER		STANDARD TORQUE	
inches	millimeters	lb. ft.	mkg
Standard thread 		Use these torques for bolts and nuts with standard threads.	
1/4	6.35	9 ± 3	1.24 ± 0.4
5/16	7.94	18 ± 5	2.5 ± 0.7
3/8	9.53	32 ± 5	4.4 ± 0.7
7/16	11.11	50 ± 10	6.9 ± 1.4
1/2	12.70	75 ± 10	10.4 ± 1.4
9/16	14.29	110 ± 15	15.2 ± 2.0
5/8	15.88	150 ± 20	20.7 ± 2.8
3/4	19.05	265 ± 35	36.6 ± 4.8
7/8	22.23	420 ± 60	58.1 ± 8.3
1	25.40	640 ± 80	88.5 ± 11.1
1 1/8	28.58	800 ± 100	110.6 ± 13.8
1 1/4	31.75	1000 ± 120	138 ± 16.6
1 3/8	34.93	1200 ± 150	166 ± 20.7
1 1/2	38.10	1500 ± 200	207 ± 27.7
		Use these torques for bolts and nuts on hydraulic valve bodies.	
5/16	7.94	13 ± 2	1.8 ± 0.3
3/8	9.53	24 ± 2	3.3 ± 0.3
7/16	11.11	39 ± 2	5.4 ± 0.3
1/2	12.70	60 ± 3	8.3 ± 0.4
5/8	15.88	118 ± 4	16.3 ± 0.5
Taperlock stud 		Use these torques for studs with Taperlock threads.	
1/4	6.35	5 ± 2	0.69 ± 0.3
5/16	7.94	10 ± 3	1.4 ± 0.4
3/8	9.53	20 ± 3	2.8 ± 0.4
7/16	11.11	30 ± 5	4.1 ± 0.7
1/2	12.70	40 ± 5	5.5 ± 0.7
9/16	14.29	60 ± 10	8.3 ± 1.4
5/8	15.88	75 ± 10	10.4 ± 1.4
3/4	19.05	110 ± 15	15.2 ± 2.0
7/8	22.23	170 ± 20	23.5 ± 2.8
1	25.40	260 ± 30	35.9 ± 4.1
1 1/8	28.58	320 ± 30	44.2 ± 4.1
1 1/4	31.75	400 ± 40	55 ± 5.5
1 3/8	34.93	480 ± 40	66 ± 5.5
1 1/2	38.10	550 ± 50	76 ± 7

T95416-5

FUEL INJECTION EQUIPMENT

Firing order (injection sequence) 1, 5, 3, 6, 2, 4

Injection timing before TC (top center) .... 14° 17'

(1) Torque for bushing .... 150 ± 10 lb.ft. (20.7 ± 1.4 mkg)

(2) Thickness of spacers:

5M2697 Spacer .... .170 in. (4.32 mm)
2M4208 Spacer .... .174 in. (4.42 mm)
2M4209 Spacer .... .178 in. (4.52 mm)
2M4210 Spacer .... .182 in. (4.62 mm)
2M4211 Spacer .... .186 in. (4.72 mm)
2M4212 Spacer .... .190 in. (4.83 mm)
5M2691 Spacer .... .194 in. (4.93 mm)
5S7189 Spacer .... .198 in. (5.03 mm)

(3) 1S7592 Spring:

Length under test force .... 1.522 in. (38.66 mm)
Test force .... 22.6 ± 1.1 lb. (10.25 ± 5 kg)
Free length after test .... 1.751 in. (44.47 mm)
Outside diameter .... .995 in. (25.27 mm)

(4) Timing dimension for the fuel injection pumps:

On engine with 8S7167 Gauge ..... 4.2956 ± .0020 in. (109.108 ± 0.051 mm)
Off engine with 8S7167 Gauge .... 4.3689 ± .0020 in. (110.970 ± 0.051 mm)

(5) Length of pump plunger .... 2.7212 ± .0015 in. (69.118 ± 0.038 mm)

Minimum permissible length .... 2.7147 in. (68.953 mm)

(6) Bore in the bearings for the rack:

Bearing at the rear .... .5018 ± .0018 in. (12.746 ± 0.046 mm)
Bearing at the front ... .5023 ± .0018 in. (12.758 ± 0.046 mm)
Diameter of fuel rack .. .4985 ± .0002 in. (12.662 ± 0.005 mm)

Maximum permissible clearance between rack and bearings:

rear .... .005 in. (0.13 mm)
front .... .006 in. (0.15 mm)

(7) Bore in bearings for the camshaft .... 2.1250 ± .0005 in. (53.975 ± 0.013 mm)

Diameter of bearing surfaces (journals) of the camshaft .... 2.1220 ± .0005 in. (53.899 ± 0.013 mm)

Maximum permissible clearance between the bearings and the camshaft bearing surfaces (journal) .... .010 in. (0.25 mm)

(8) Torque for the nuts that hold the fuel lines using the 5P144 Fuel Line Socket .... 30 ± 5 lb.ft. (4.1 ± 0.7 mkg)

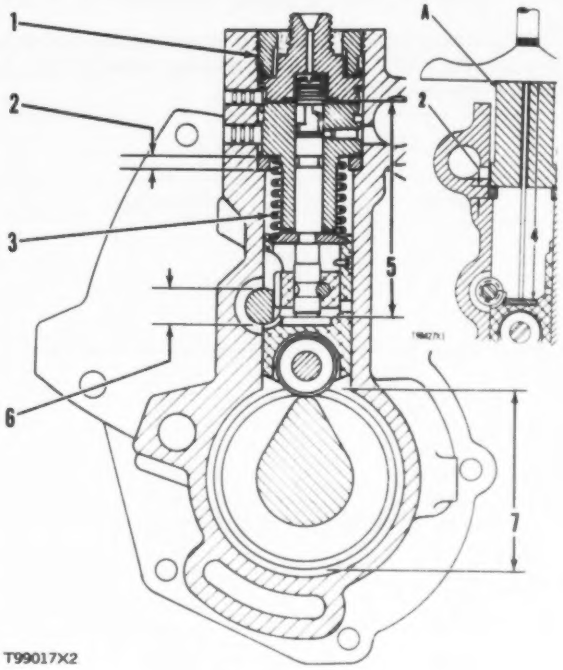
(9) Torque for the nuts that hold the nozzles .... 105 ± 5 lb.ft. (14.5 ± 0.7 mkg)

(10) Body.

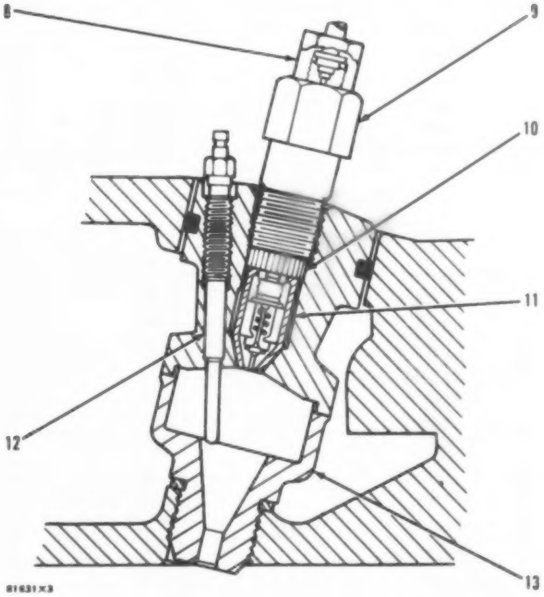
(11) Tighten nozzle finger tight in body (10).

(12) Torque for glow plug ..... 108 ± 12 lb.in. (124.5 ± 13.8 cm.kg)

(13) Torque for precombustion chamber ...... 200 lb.ft. (17.7 mkg)

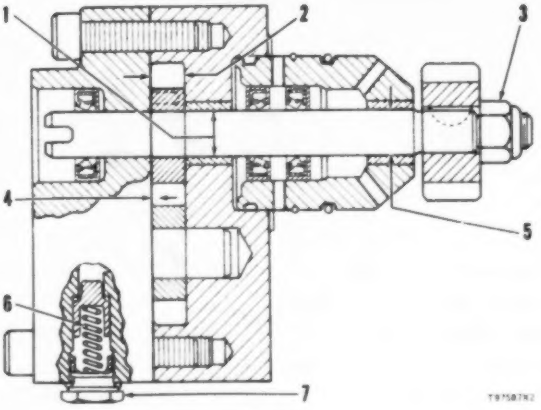


A. 8S7167 Gauge



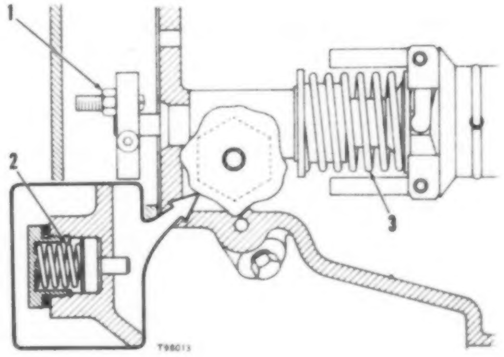
NOTE: FOR TORQUE VALUES NOT GIVEN, SEE THE FIRST PAGE OF SPECIFICATIONS FOR GENERAL TIGHTENING TORQUES

FUEL TRANSFER PUMP
(2P5194)



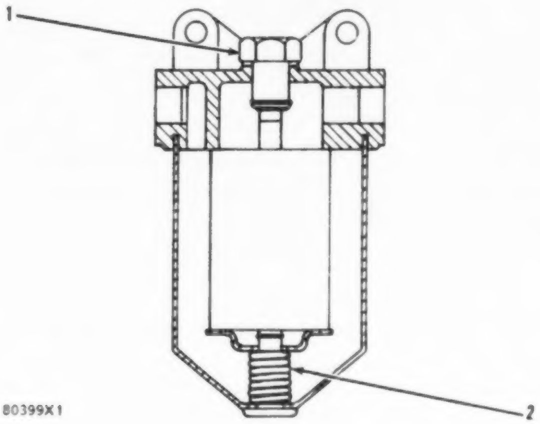
	Pressure of fuel to injection pump	32 ± 7 psi (2.25 ± 0.49 kg/cm²)
(1)	Bore of bearing	.4953 ± .0003 in. (12.581 ± 0.008 mm)
(2)	Depth of bore in body	.3750 ± .0003 in. (9.525 ± 0.008 mm)
(3)	Torque for nut	22 ± 5 lb.ft. (3.0 ± 0.7 mkg)
(4)	Clearance between gear and cover	.0014 to .0026 in. (0.036 to 0.066 mm)
	Maximum permissible clearance between gear and cover	.0035 in. (0.089 mm)
(5)	Shaft diameter	.4937 ± .0001 in. (12.540 ± 0.003 mm)
	Bore in shaft bearing	.4953 ± .0003 in. (12.581 ± 0.008 mm)
	Maximum permissible clearance between shaft and bearing	.003 in. (0.08 mm)
(6)	2P4252 Spring:	
	Length under test force	1.34 in. (34.0 mm)
	Test force	5.82 lb. (2.6 kg)
	Free length after test	1.97 in. (50.0 mm)
	Outside diameter	.406 in. (10.31 mm)
(7)	Torque for plug	40 ± 5 lb.ft. (5.5 ± 0.7 mkg)

GOVERNOR



(1)	Torque for nut	11 ± 1 lb.ft. (1.52 ± 0.14 mkg)
(2)	1S9312 Spring for speed limiter:	
	Length under test force	.86 in. (21.84 mm)
	Test force	2.38 ± .19 lb. (1.08 ± 0.09 kg)
	Free length after test	2.62 in. (66.55 mm)
	Outside diameter	.671 in. (17.04 mm)
(3)	4N5693 Spring for governor:	
	Put force on spring of	5.42 lb. (2.46 kg)
	Then add more force to make spring shorter by	.300 in. (7.62 mm)
	Total test force	8.00 ± .40 lb. (3.63 ± .18 kg)
	Free length after test	2.485 ± .030 in. (63.12 ± .76 mm)
	Outside diameter	1.361 ± .015 in. (34.57 ± .38 mm)

PRIMARY FUEL FILTER



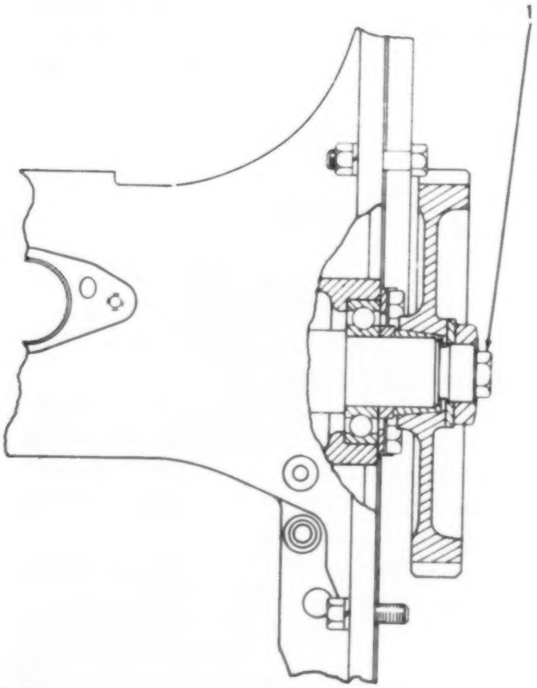
80399X1

(1) Tighten nut to .... 23 ± 3 lb.ft. (3.2 ± 0.4 mkg)

(2) 7S9323 Spring:

Length under test force	1.10 in. (27.9 mm)
Test force	27.7 to 32.3 lb. (12.6 to 14.7 mm)
Free length after test	1.68 in. (42.7 mm)
Outside diameter	.682 in. (17.32 mm)

ACCESSORY DRIVE GROUP

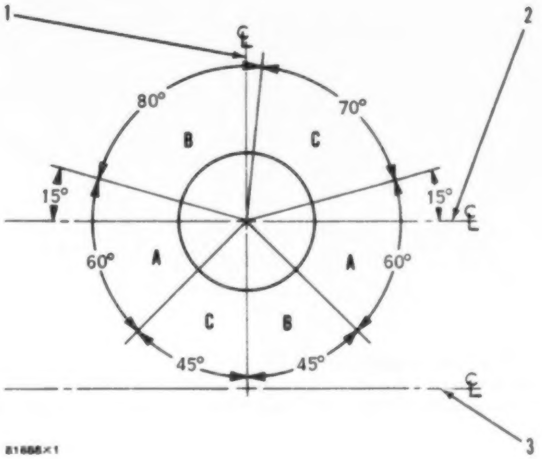


74510X1

(1) Torque for nut .... 125 ± 10 lb.ft. (17.3 ± 1.4 mkg)

NOTE: FOR TORQUE VALUES NOT GIVEN, SEE THE FIRST PAGE OF SPECIFICATIONS FOR GENERAL TIGHTENING TORQUES

GLOW PLUG POSITIONING



(1) Center line of the precombustion chamber that is at a right angle to the center line of the crankshaft.

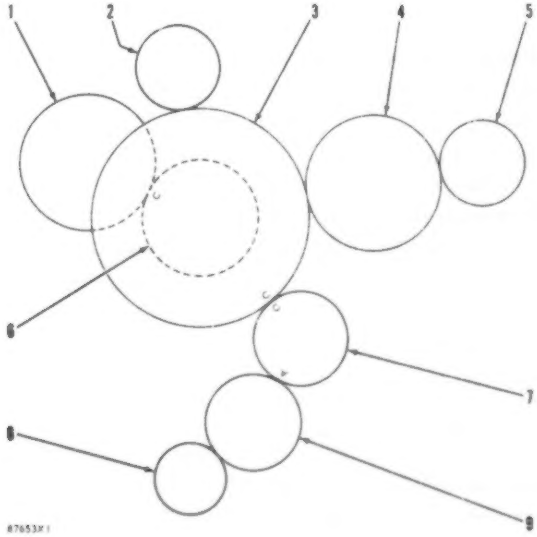
(2) Center line of the precombustion chamber that is parallel to the center line of the crankshaft.

(3) Center line of the crankshaft.

Put 9M3710 Anti-Seize Compound on the threads of the precombustion chamber.

NOTE: Put 1P6442 Gasket, with "4D" on it, on the precombustion chamber. Install the precombustion chamber in the cylinder head and tighten the precombustion chamber to 200 lb.ft. (27.7 mkg). If the opening for the glow plug is not in the "A range", remove the precombustion chamber and 1P6442 Gasket. If the opening for the glow plug was in the "B range" use 1P6441 Gasket with "4J" on it. If the opening for the glow plug was in the "C range" use 5H2579 Gasket with "4C" on it. Install the precombustion chamber in the cylinder head with the correct gasket and tighten the precombustion chamber to 200 lb.ft. (27.7 mkg). After installation of precombustion chamber, the opening for glow plug must be in the "A range".

TIMING GEARS



(1) 1P7321 Gear; for fuel pump drive and accessory drive.

(2) 4H9448 Gear; for drive shaft for power take off.

(3) 4H7384 Gear; large outer gear on camshaft.

(4) 2M6548 Gear; water pump drive idler.

(5) 2M6569 Gear; water pump drive.

(6) 2M4091 Gear; small inner gear on camshaft.

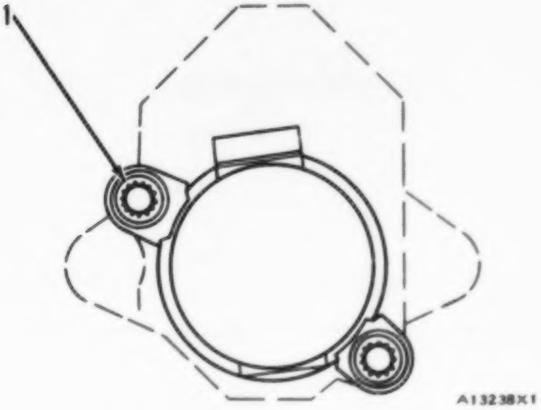
(7) 6N2142 Gear; on crankshaft.

(8) 6N2141 Gear; oil pump drive.

(9) 2F7651 Gear; oil pump drive idler.

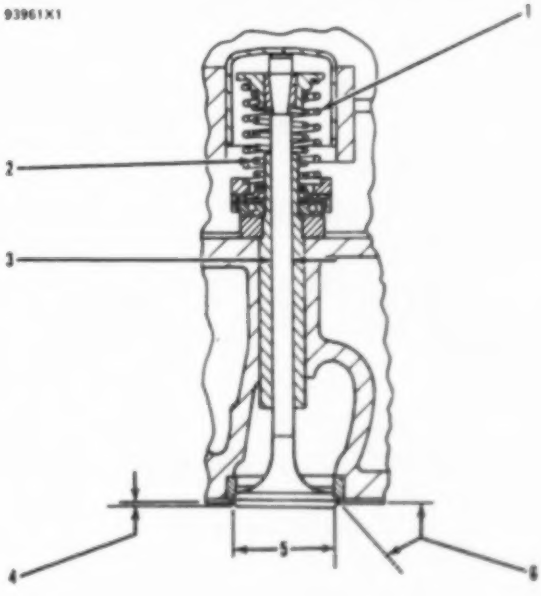
NOTE: Timing mark "A" on gear (7) is not for this engine.

SERVICE METER



(1) Torque for bolts holding service meter
to transfer pump .... 96 ± 24 lb.in. (110.7 ± 27.6 cm.kg)

VALVES



(1) 9M5350 Spring for valve (outer):

Length under test force .... 2.219 in. (56.36 mm)

Test force .... 65 ± 3 lb. (29.5 ± 1.4 kg)

Free length after test .... 2.574 in. (65.38 mm)

Outside diameter .... 1.713 in. (43.51 mm)

(2) 9M5349 Spring for valve (inner):

Length under test force .... 1.791 in. (45.49 mm)

Test force .... 20 ± 1 lb. (9.1 ± 0.5 kg)

Free length after test .... 2.179 in. (55.35 mm)

Outside diameter .... 1.125 in. (28.58 mm)

(3) Diameter of valve
stem .... .4955 ± .0005 in. (12.586 ± 0.013 mm)

Minimum permissible diameter
of valve stem .... .4935 in. (12.535 mm)

Bore in valve guide with guide installed in the head:

Exhaust valve .... .5010 ± .0010 in. (12.725 ± 0.025 mm)

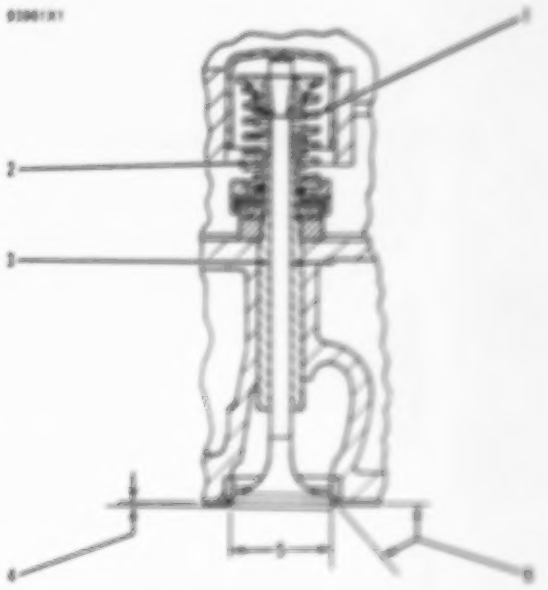
Intake valve .... .5010 ± .0010 in. (12.725 ± 0.025 mm)

Maximum permissible diameter of bore in valve guide:

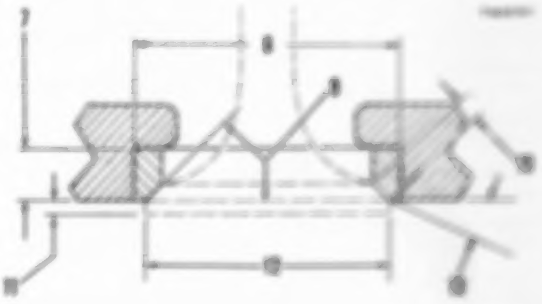
Exhaust valve .... .5025 in. (12.764 mm)

Intake valve .... .5025 in. (12.764 mm)

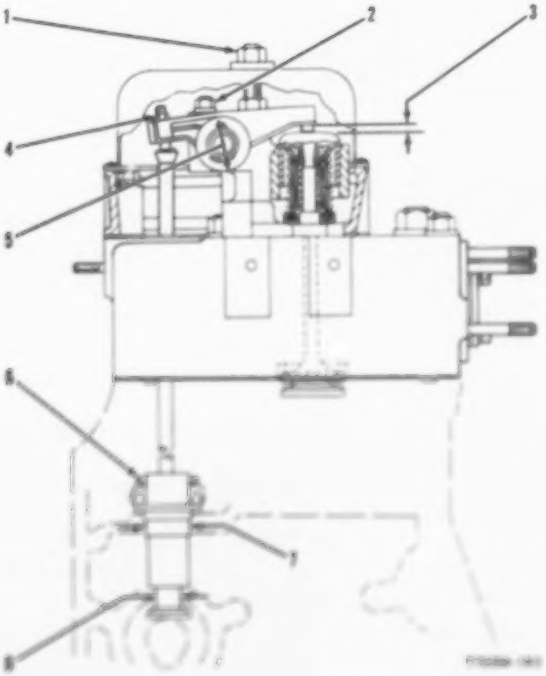
Valves (Cont.)



(4)	Thickness of valve lip:	
	Exhaust valve, minimum permissible	.106 in. (2.69 mm)
	Intake valve, minimum permissible	.158 in. (4.01 mm)
(5)	Diameter of valve head:	
	Exhaust valve	2.282 ± .005 in. (57.96 ± 0.13 mm)
	Intake valve	2.343 ± .005 in. (59.51 ± 0.13 mm)
(6)	Angle of valve face	44° 30' ± 0° 15'
(7)	Depth of bore in head for valve seat insert	.509 ± .001 in. (12.93 ± 0.03 mm)
(8)	Diameter of valve seat insert	2.5030 ± .0005 in. (63.576 ± 0.013 mm)
	Bore in head for valve seat insert	2.5000 ± .0005 in. (63.500 ± 0.013 mm)
(9)	Angle of face of valve seat insert	45° 00' ± 0° 15'
(10)	Maximum permissible width of valve seat:	
	Exhaust valve	.197 in. (5.00 mm)
	Intake valve	.160 in. (4.06 mm)
(11)	Dimension from top of closed valve to face of head:	
	Maximum permissible dimension for exhaust valve	.130 in. (3.30 mm)
	Minimum permissible dimension for exhaust valve	.080 in. (2.03 mm)
	Maximum permissible dimension for intake valve	.185 in. (4.70 mm)
	Minimum permissible dimension for intake valve	.137 in. (3.48 mm)
(12)	Outside diameter of the face of the valve seat insert:	
	Exhaust seat	2.2865 ± .0015 in. (57.989 ± 0.038 mm)
	Maximum permissible, exhaust seat	2.291 in. (58.19 mm)
	Intake seat	2.3195 ± .0015 in. (58.915 ± 0.038 mm)
	Maximum permissible, intake seat	2.343 in. (59.51 mm)
(13)	Angle to grind seat face of the insert to get a reduction of maximum seat diameter	15°



VALVE ROCKER ARMS AND LIFTERS



(1) Torque for nuts holding valve covers approximately .... 25 lb.ft. (3.5 mkg)

(2) Torque for nuts holding bracket for rocker arm shaft .... 30 ± 5 lb.ft. (4.1 ± 0.7 mkg)

(3) Clearance for valves:

Exhaust valves .... .020 ± .003 in. (0.51 ± 0.08 mm)

Intake valves .... .016 ± .003 in. (0.41 ± 0.08 mm)

(4) Torque for locknut on valve adjustment screw .... 40 ± 5 lb. (5.5 ± 0.7 mkg)

(5) Diameter of shaft .... 1.223 to 1.224 in. (31.06 to 31.09 mm)

Bore in bearing for shaft .... 1.2255 ± .0005 in. (31.128 ± 0.013 mm)

Maximum permissible clearance between bearing and shaft .... .010 in. (0.25 mm)

(6) Torque for bolts holding guide for valve lifter (follower) .... 25 ± 5 lb.ft. (3.5 ± 0.7 mkg)

(7) Diameter of guide for valve lifter (follower) .... [illegible] ± .001 in. ([illegible] ± 0.03 mm)

Bore in block for guide for valve lifter (follower) .... [illegible] ± .001 in. ([illegible] ± 0.03 mm)

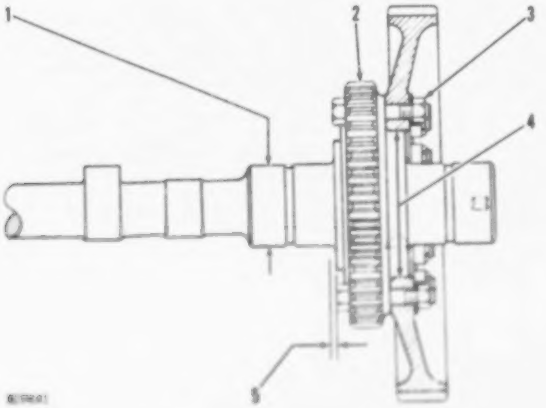
(follower) .... .9965 ± .0005 in. (25.311 ± 0.013 mm)

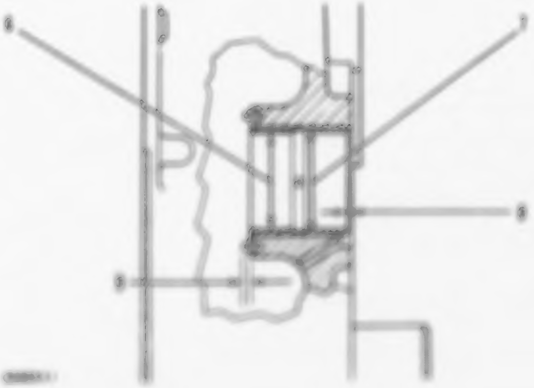
Bore in guide for valve lifter (follower) .... .9995 ± .0005 in. (25.387 ± 0.013 mm)

Maximum permissible clearance between lifter (follower) and bore in guide .... .008 in. (0.20 mm)

NOTE: FOR TORQUE VALUES NOT GIVEN, SEE THE FIRST PAGE OF SPECIFICATIONS FOR GENERAL TIGHTENING TORQUES

CAMSHAFT





(1) Diameter of bearing surface (journal) of the camshaft .... 2.6185 ± .0005 in. (66.510 ± 0.013 mm)

(2) Get temperature of the gear to a maximum of 750°F (399°C) before installation on the camshaft.

(3) Torque for nuts .... 75 ± 10 lb.ft. (10.4 ± 1.4 mkg)

(4) Diameter of seat for gear .... [illegible]

Bore in gear .... [illegible]

(5) End play for the camshaft .... .010 to .020 in. (0.25 to 0.51 mm)

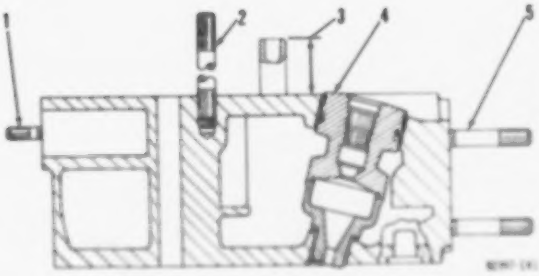
Maximum permissible end play for the camshaft .... .030 in. ([illegible] mm)

(6) Bore in bearings for camshaft .... [illegible]

(8) Distance from bearing to face of housing .... .03 in. (0.8 mm)

(9) Distance from end of dowel to face of housing .... .19 in. (4.8 mm)

CYLINDER HEAD



(1) Torque for studs for water manifold .... 20 ± 5 lb.ft. (2.8 ± 0.7 mkg)

(2) Torque for studs for valve covers .... 50 ± 5 lb.ft. (6.9 ± 0.7 mkg)

(3) Distance from face of cylinder head to the end of valve guides .... 1.690 ± .020 in. (42.93 ± 0.51 mm)

(4) Torque for precombustion chamber (put 5M2710 Anti-Seize Compound on threads) .... 200 lb.ft. (27.7 mkg)

(5) Torque for studs for exhaust manifold .... 40 ± 5 lb.ft. (5.5 ± 0.7 mkg)

Put 4S9416 Anti-Seize Compound on stud threads and tighten nuts in the following Step sequence:

Step 1. Tighten all nuts in number sequence to .... 60 lb.ft. (8.3 mkg)

Step 2. Tighten all nuts in letter sequence to .... 150 lb.ft. (20.7 mkg)

Step 3. Again tighten all nuts in letter sequence to .... 300 lb.ft. (41.5 mkg)

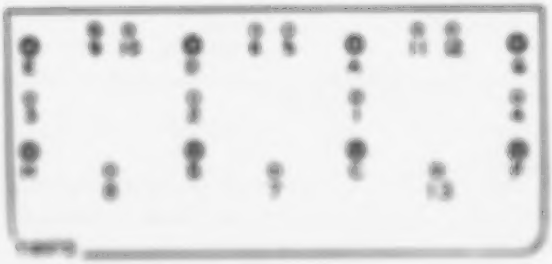
Step 4. Again tighten all nuts in number sequence to .... 120 lb.ft. (16.6 mkg)

Step 5. Again tighten all nuts in letter sequence (final torque only) to .... 300 lb.ft. (41.5 mkg)

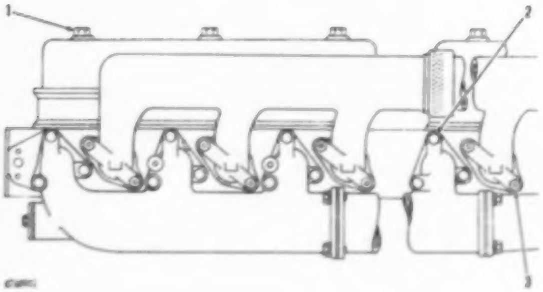
Step 6. Again tighten all nuts in number sequence [illegible]

Step 7. [illegible] engine test to .... 105 lb.ft. (14.5 mkg)

Step 8. Retorque all nuts in letter sequence after engine test to .... 260 lb.ft. (36.0 mkg)



VALVE COVER AND MANIFOLDS

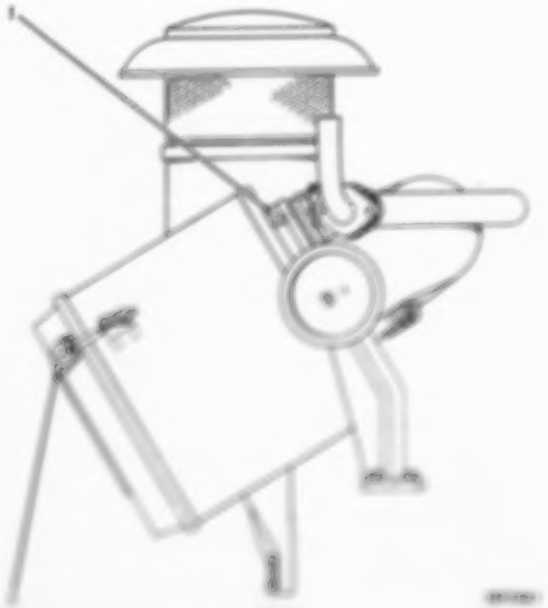


(1) Torque for nuts holding valve cover, approximately .... 25 lb.ft. (3.5 mkg)

(2) Torque for bolts holding inlet manifold .... 75 ± 10 lb.ft. (10.4 ± 1.4 mkg)

(3) Torque for nuts holding exhaust manifold (put 8M2771 Anti-Seize Compound on threads) .... 75 ± 10 lb.ft. (10.4 ± 1.4 mkg)

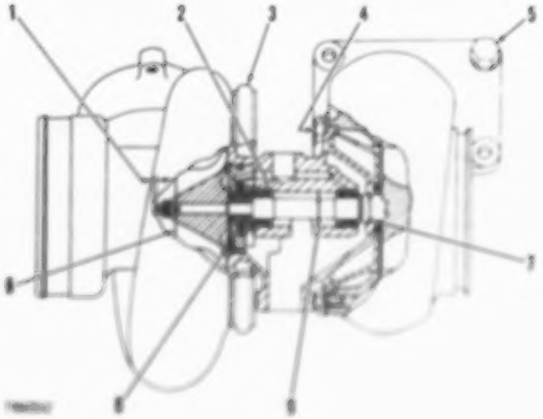
AIR CLEANER



(1) Torque [illegible] .... [illegible]

Torque fixing bolt .... 35 ± 5 lb.in. (40.4 ± 5.8 cm.kg)

TURBOCHARGER
(AiResearch T1235)



(1) End play for shaft .... .006 to .011 in. (0.15 to 0.27 mm)

(2) Bore in the bearing .... .6268 to .6272 in. (15.921 to 15.931 mm)

Diameter of journal for the bearing .... .6250 to .6254 in. (15.875 to 15.885 mm)

(3) Torque for bolt holding compressor housing clamp .... 120 ± 10 lb.in. (138.4 ± 11.5 cm.kg)

(4) Put 8M2710 or 4S9416 Anti-Seize Compound on threads of bolts holding turbine housing and tighten to .... 175 ± 15 lb.in. (201.8 ± 17.3 cm.kg)

(5) Put 8M2710 or 4S9416 Anti-Seize Compound on threads of bolts holding turbocharger to manifold and tighten to .... 45 ± 5 lb.ft. (6.22 ± .69 mkg)

(6) Install impeller as follows:

a. Get temperature of impeller to .... 350°F (177°C)

b. Install impeller on shaft.

c. Tighten nut to .... 120 lb.in. (138.4 cm.kg)

d. Let impeller cool to below .... [illegible] (38°C)

e. Loosen nut and put lubricant on threads.

f. Tighten nut to .... [illegible]

g. Tighten nut an added .... [illegible]

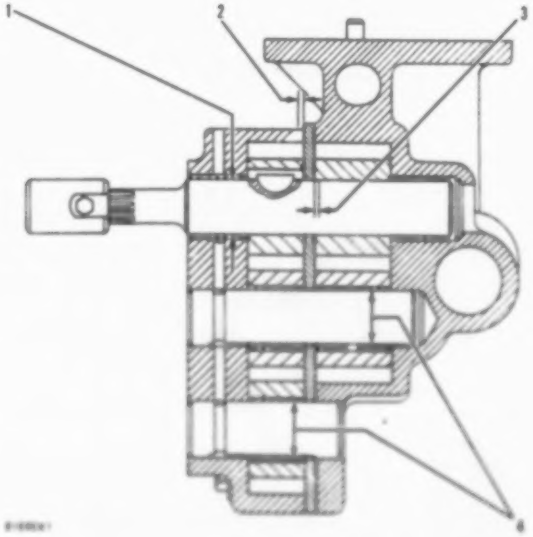
(7) Clearance between ends of oil seal ring .... [illegible]

(8) Torque for bolts holding thrust plate .... [illegible]

(9) Bore in housing .... [illegible]

NOTE: FOR TORQUE VALUES NOT GIVEN, SEE THE FIRST PAGE OF SPECIFICATIONS FOR GENERAL TIGHTENING TORQUES

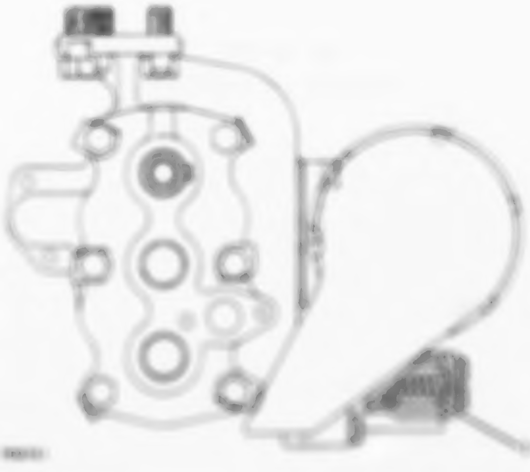
OIL PUMP



Pressure of SAE 10 oil at 200 ± 10°F (93 ± 6°C) when measured at the clean side of the oil filter at the oil filter base:

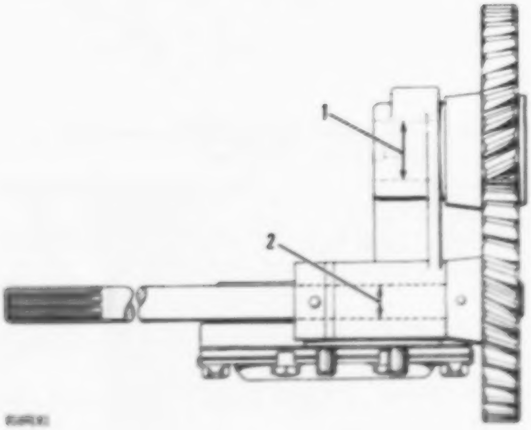
	Full load rpm	43 ± 7 psi (2.74 ± 0.49 kg/cm²)
	Low idle rpm (minimum)	18 psi (1.62 kg/cm²)
(1)	Diameter of the drive shaft	1.2278 ± .0003 in. (31.186 ± 0.008 mm)
	Bore in the bearings for the drive shaft	1.2305 ± .0005 in. (31.255 ± 0.013 mm)
	Maximum permissible clearance between shaft and bearings	.006 in. (0.15 mm)
(2)	Clearance between gears and spacer	.0020 to .0046 in. (0.051 to 0.117 mm)
(3)	Clearance between gears and spacer	.0030 to .0056 in. (0.076 to 0.142 mm)
(4)	Diameter of the idler shafts	1.2278 ± .0003 in. (31.186 ± 0.008 mm)
	Bore in the bearings in the gears for the idler shafts	1.2305 ± .0005 in. (31.255 ± 0.013 mm)

OIL PUMP VALVE



(1)	[illegible] Spring for oil pump relief valve	
	Length under test force	[illegible]
	Test force	[illegible]
	Free length after test	[illegible]

OIL PUMP DRIVE



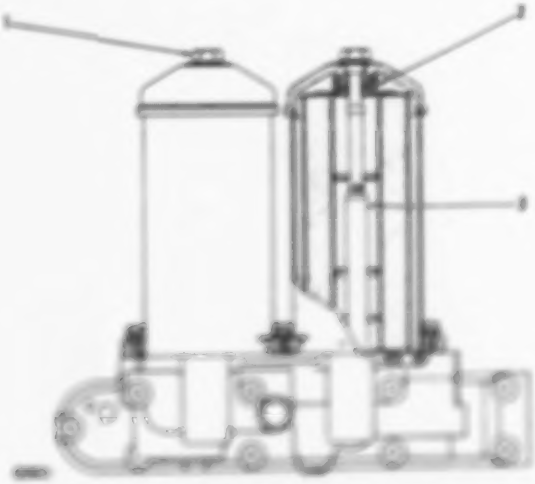
(1) Diameter of the shaft for the drive idler gear .... 1.2475 to 1.2485 in. (31.687 to 31.712 mm)

Bore in bearing for the shaft .... 1.250 to 1.251 in. (31.75 to 31.78 mm)

(2) Diameter of the drive shaft for the oil pump .... .7410 ± .0005 in. (18.821 ± 0.013 mm)

Bore in bearing for the drive shaft for the oil pump .... .744 ± .001 in. (18.90 ± 0.03 mm)

OIL FILTER
(DOUBLE OIL FILTER)



(1) Torque for screw holding case assembly to oil filter case .... [illegible]

(2) [illegible] Spring

Length under test force .... [illegible]

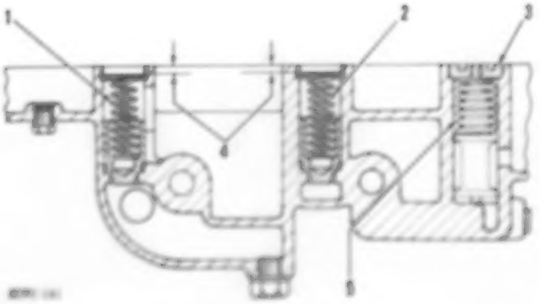
Test force .... [illegible]

Free length after test .... [illegible]

Outside diameter .... [illegible]

OIL FILTER BASE

(2S8877 Oil Filter Assembly)



Oil pressure that makes the oil filter bypass valve open .... 26 ± 3 psi (1.83 ± 0.21 kg/cm²)

Oil pressure that makes the oil cooler bypass valve open .... 26 ± 3 psi (1.83 ± 0.21 kg/cm²)

(1) 8M2183 Spring for bypass valve for the oil filter:

Length under test force .... 2.50 in. (63.5 mm)

Test force .... 8.82 lb. (4.0 kg)

Free length after test .... 3.61 in. (91.7 mm)

Outside diameter .... .81 in. (20.6 mm)

(2) 8M2183 Spring for bypass valve for the oil cooler:

Length under test force .... 2.50 in. (63.5 mm)

Test force .... 8.82 lb. (4.0 kg)

Free length after test .... 3.61 in. (91.7 mm)

Outside diameter .... .81 in. (20.6 mm)

(3) [illegible] Retainer

NOTE: Retainer (3) must be even with the face of the filter base after installation.

(4) Distance from face of filter base to inside face of plug .... .31 in. (7.9 mm)

(5) [illegible] Spring for turbocharger lubrication valve:

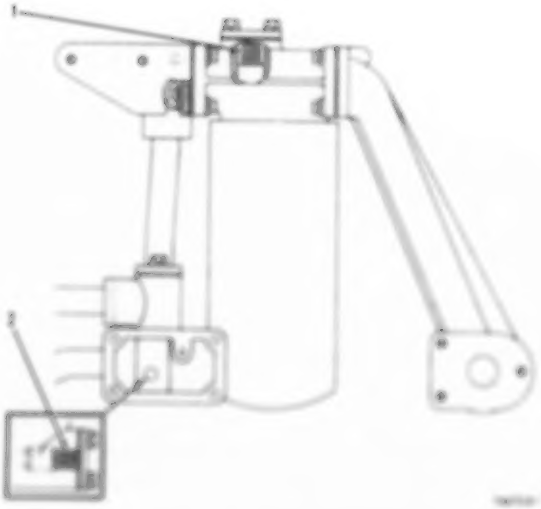
Length under test force .... 1.50 in. (38.1 mm)

Test force .... 28.80 ± 2.80 lb. (13.0 ± 1.1 kg)

Free length after test .... 2.80 in. (71.1 mm)

Outside diameter .... 1.02 in. (26.1 mm)

OIL FILTER BASE
(SINGLE OIL FILTER)
(2P5103 Oil Filter Group)



Oil pressure that makes the oil filter bypass valve open .... 25 ± 3 psi (1.8 ± 0.2 kg/cm²)

Oil pressure that makes the oil cooler bypass valve open .... 25 ± 3 psi (1.8 ± 0.2 kg/cm²)

(1) [illegible] Spring for bypass valve of the oil filter

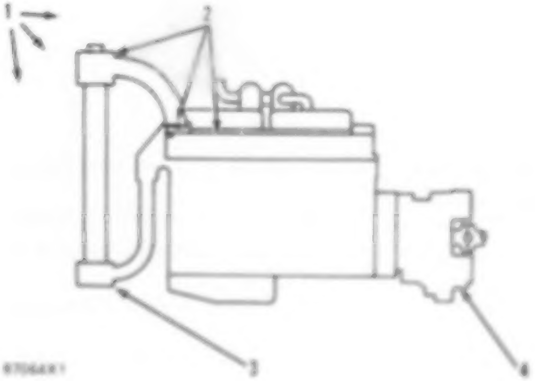
Length under test force	2.50 in. (63.5 mm)
Test force	8.80 lb. (4.0 kg)
Free length after test	3.61 in. (91.7 mm)
Outside diameter	.81 in. (20.6 mm)

(2) [illegible] Spring for bypass valve for the oil cooler

Length under test force	2.50 in. (63.5 mm)
Test force	8.80 lb. (4.0 kg)
Free length after test	3.61 in. (91.7 mm)
Outside diameter	.81 in. (20.6 mm)

NOTE: FOR TORQUE VALUES NOT GIVEN, SEE THE FIRST PAGE OF SPECIFICATIONS FOR STANDARD TORQUES

COOLING SYSTEM



Make the temperature measurements below during a typical operating cycle.

Difference between top tank (2) and air away from engine (1) must not be more than .... 110°F (61°C)

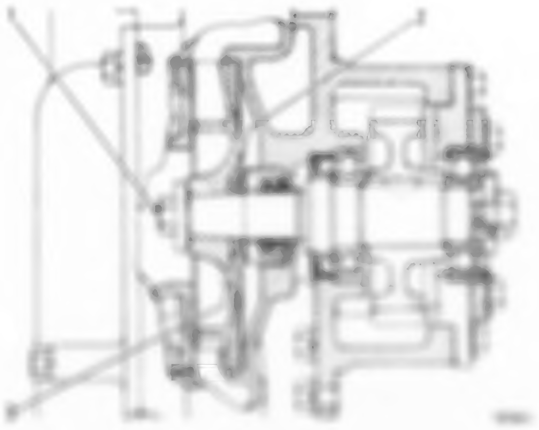
Difference between top tank (2) and bottom tank (3) must be less than .... 15°F (8°C)

Difference between top tank (2) and torque converter oil outlet (4) must not be more than .... 40°F (22°C)

NOTE: At stall condition the normal temperature of the torque converter oil must not be more than 270°F (132°C) for any extended period of time.

When regulators are open difference between top tank (2) and regulator housing (2) must not be more than .... 2°F (1°C)

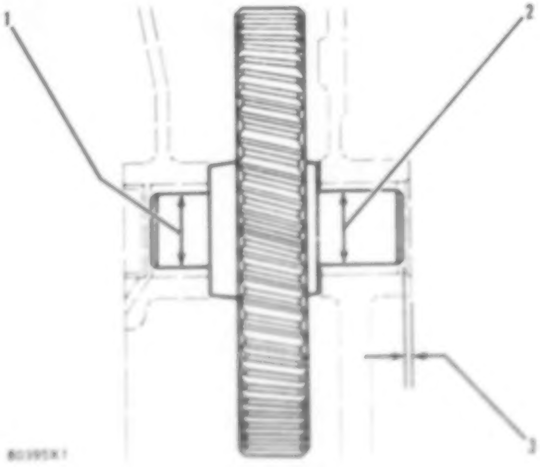
WATER PUMP



(1) Torque for bolt .... [illegible]

(2), (4) Put smooth surface of ring (3) against carbon surface of seal (4).

WATER PUMP IDLER GEAR



(1) Diameter of shaft . . 1.4320 to 1.4325 in. (36.373 to 36.386 mm)

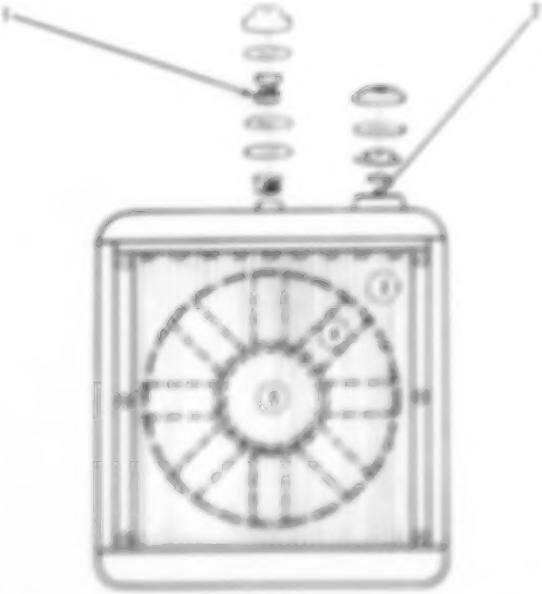
Bore in bearing
for shaft . . . . 1.4350 ± .0005 in. (36.450 ± 0.013 mm)

(2) Diameter of shaft . . 1.4940 to 1.4945 in. (37.948 to 37.960 mm)

Bore in bearing
for shaft . . . . 1.4970 ± .0005 in. (38.024 ± 0.013 mm)

(3) Dimension from end of shaft to
outer face of front cover . . . . .188 in. (4.78 mm)

RADIATOR



(1) [illegible] Pressure relief valve

Pressure that makes the relief valve
open . . . . [illegible]

(2) Torque for seal for the
filler cap . . . . [illegible]

[illegible]

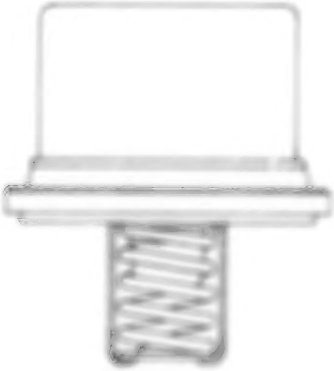
[illegible] (3) . . . . [illegible]

[illegible] (4) . . . . [illegible]

[illegible] (5) . . . . [illegible]

NOTE: FOR TORQUE VALUES NOT GIVEN, SEE THE FIRST PAGE OF SPECIFICATIONS FOR GENERAL TIGHTENING TORQUES

WATER TEMPERATURE REGULATORS



[illegible] Regulator:

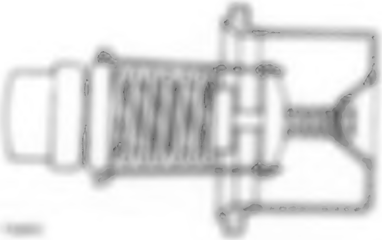
Temperature when completely open .... 197°F (92°C)

Minimum opening distance .... .375 in. (9.53 mm)

[illegible] Regulator:

Temperature when completely open .... 180°F (82°C)

Minimum opening distance .... .375 in. (9.53 mm)

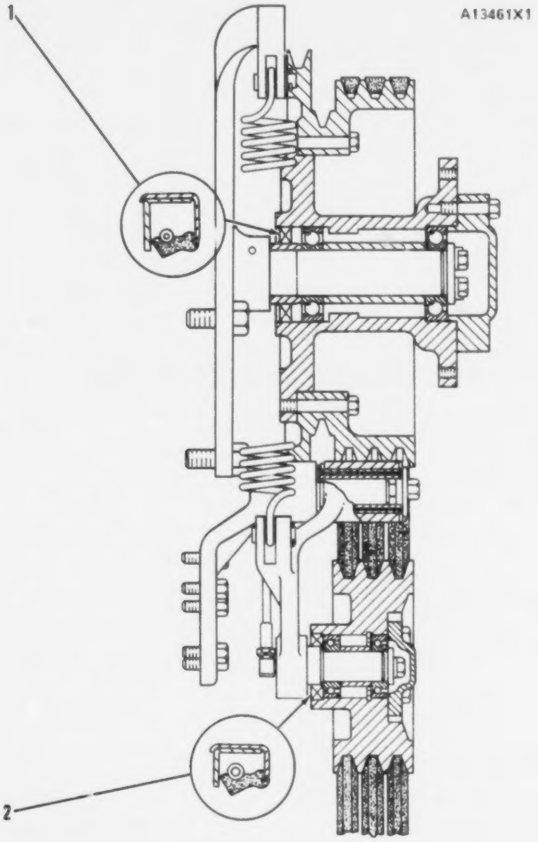


[illegible] Regulator:

Temperature when completely open .... [illegible]

Minimum opening distance .... .375 in. (9.53 mm)

FAN DRIVE



Fan speed at engine speed of 1280 rpm .... 1210 rpm

(1) Install seal with lip as shown in detail.

(2) Install seal with lip as shown in detail.

V-BELT TENSION CHART

BELT SIZE	WIDTH BELT TOP		WIDTH TOP OF PULLEY GROOVE		BELT TENSION "INITIAL"*	BELT TENSION "USED"**	BORROUGHS GAGE NO.
	in.	mm	in.	mm	GAGE READING	GAGE READING	
3/8	.422	25.82	.380	9.65	100 ± 5	45 ± 5	BT-33-73F
1/2	.547	13.89	.500	12.70	120 ± 5	90 ± 10	BT-33-96-4-16
5V	.625	15.88	.600	15.24	120 ± 5	90 ± 10	BT-33-72-4-15
11/16	.688	17.48	.625	15.88	120 ± 5	90 ± 10	BT-33-72-4-15
3/4	.750	19.05	.690	41.34	120 ± 5	90 ± 10	BT-33-72-4-15
15/16	.938	23.83	.878	22.30	120 ± 5	90 ± 10	BT-33-72-4-15

MEASURE TENSION OF BELT FARTHEST FROM THE ENGINE

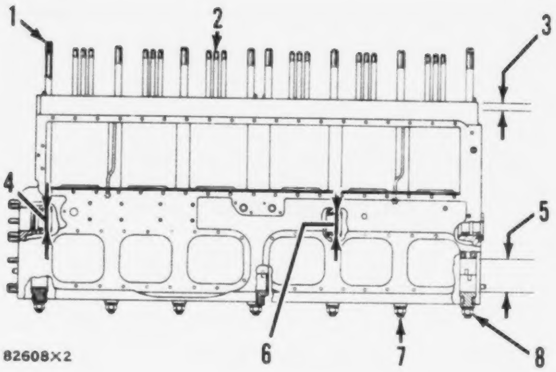
*"INITIAL" BELT TENSION is for a new belt.

**"USED" BELT TENSION is for a belt which has more than 30 minutes of operation at rated speed of engine.

A10232X1

NOTE: FOR TORQUE VALUES NOT GIVEN, SEE THE FIRST PAGE OF SPECIFICATIONS FOR GENERAL TIGHTENING TORQUES

CYLINDER BLOCK



(1) Torque for 7/8 in. studs for head .... 170 ± 20 lb.ft. (23.5 ± 2.8 mkg)

(2) Torque for 5/8 in. studs for head .... 75 ± 10 lb.ft. (10.4 ± 1.4 mkg)

(3) Depth of bore in block for liner .... .492 to .494 in. (12.50 to 12.55 mm)

Maximum permissible depth of bore after reconditioning .... .553 in. (14.05 mm)

Height of liner over block, under installation pressure .... .004 to .008 in. (0.10 to 0.20 mm)

Maximum permissible difference in height of liners next to each other .... .001 in. (0.03 mm)

Maximum permissible difference between high and low measurements made at four places around each cylinder liner .... .001 in. (0.03 mm)

(4) Bore in bearings for camshaft .... 2.6243 ± .0012 in. (66.657 ± 0.030 mm)

(5) Bore in block for main bearing .... 4.6245 ± .0005 in. (117.462 ± 0.013 mm)

(6) Bore in block for bearings for camshaft .... 2.874 to 2.875 in. (72.99 to 73.03 mm)

(7) Torque for studs for main bearing .... 170 ± 20 lb.ft. (23.5 ± 2.8 mkg)

(8) Torque for nuts holding caps for main bearings:

a. Put crankcase oil on threads and washer face.

b. Tighten both nuts to .... 100 ± 5 lb.ft. (13.8 ± 0.7 mkg)

c. Put a mark on each nut and cap.

d. Tighten each nut from mark .... 120°

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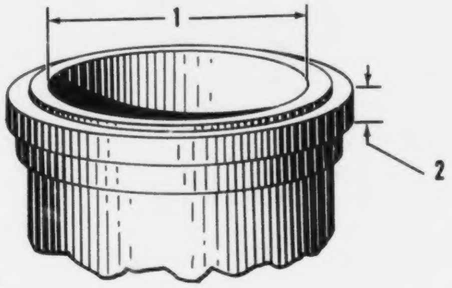
CYLINDER LINER



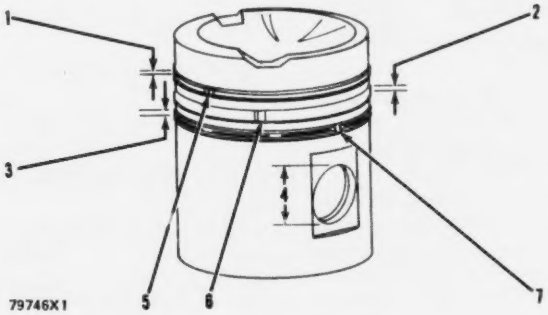
T88321

(1) Bore in liner .... 5.751 ± .001 in. (146.08 ± 0.03 mm)

Maximum permissible bore when measured near upper end of the wear surface of the cylinder liner .... 5.758 in. (146.25 mm)

(2) Thickness of flange on the liner .... .4990 ± .0008 in. (12.675 ± 0.020 mm)

PISTON AND RINGS



79746X1

(1) Clearance between top ring and groove .... .0046 to .0064 in. (0.117 to 0.163 mm)

(2) Clearance between center ring and groove .... .0030 to .0048 in. (0.076 to 0.122 mm)

(3) Clearance between oil ring and groove .... .0015 to .0035 in. (0.038 to 0.089 mm)

(4) Bore in piston for pin .... 2.3906 ± .0003 in. (60.721 ± 0.008 mm)

Maximum permissible clearance between piston pin and bore in piston .... .002 in. (0.05 mm)

Clearance between ends of piston ring installed in cylinder liner with bore size of .... 5.750 in. (146.05 mm)*

(5) Top ring .... .0305 ± .0075 in. (0.775 ± 0.191 mm)

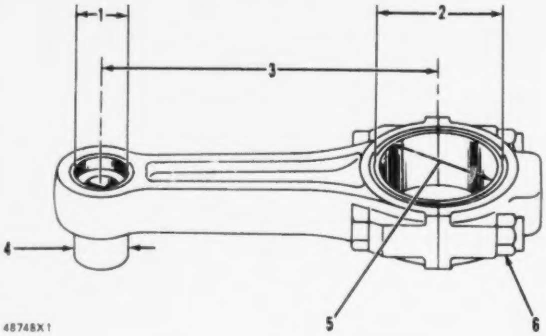
(6) Center ring .... .0285 ± .0075 in. (0.724 ± 0.191 mm)

(7) Oil control ring (bottom ring) .... .025 ± .005 in. (0.64 ± 0.13 mm)

*Increase in clearance between ends of piston ring for each .001 in. (0.03 mm) increase in cylinder liner bore size .... .003 in. (0.08 mm)

NOTE: FOR TORQUE VALUES NOT GIVEN, SEE THE FIRST PAGE OF SPECIFICATIONS FOR GENERAL TIGHTENING TORQUES

CONNECTING ROD



(1) Bore in bearing for piston pin . . . . 2.3913 ± .0003 in. (60.739 ± 0.008 mm)

Maximum permissible clearance between bearing and piston pin . . . . .003 in. (0.08 mm)

(2) Bore in connecting rod for bearing . . . . 3.9670 ± .0005 in. (100.762 ± 0.013 mm)

(3) Distance between center of bearing for piston pin and center of bearing for crankshaft . . . . 15.000 ± .001 in. (381.00 ± 0.03 mm)

(4) Diameter of piston pin . . . . 2.3898 ± .0002 in. (60.701 ± 0.005 mm)

(5) Bore in bearing for crankshaft bearing surface (journal) . . . . 3.6279 to 3.6300 in. (92.149 to 92.202 mm)

(6) Torque on nuts for connecting rod:

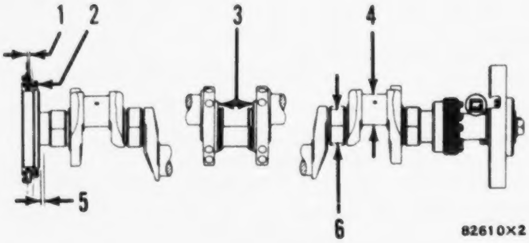
a. Put crankcase oil on threads and nut seat.

b. Tighten both nuts to . . . . 75 ± 5 lb.ft. (10.4 ± 0.7 mkg)

c. Put a mark on each nut and end of bolt.

d. Tighten each nut from mark . . . . 60°

CRANKSHAFT



Get the temperature of the thrower to a maximum of 500°F (260°C) before installation on the crankshaft.

Get the temperature of the gear to a maximum of 300°F (149°C) before installation on the crankshaft.

(1) Width of groove in thrower . . . . .2515 ± .0005 in. (6.388 ± 0.013 mm)

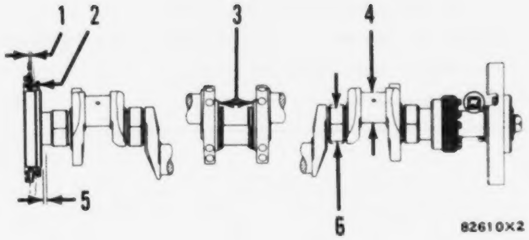
Clearance between seal ring and groove . . . . .0025 to .0045 in. (0.064 to 0.114 mm)

(2) Maximum "runout" (axial eccentricity) of groove in thrower for seal ring . . . . .006 in. (0.15 mm)

(3) Distance between thrust faces of crankshaft for center main bearing . . . . 3.8725 ± .0025 in. (98.362 ± 0.064 mm)

Distance between thrust faces of center main bearing . . . . 3.857 ± .001 in. (97.97 ± 0.03 mm)

Crankshaft (Cont.)



(4) Diameter of bearing surfaces (journals) for the connecting rods [standard, original size] . . . . 3.624 ± .001 in. (92.05 ± 0.03 mm)

Minimum permissible diameter . . . . 3.618 in. (91.90 mm)

Diameter of bearing surfaces (journals) for the connecting rods [.025 in. (0.64 mm) smaller than the original size] . . . . 3.599 ± .001 in. (91.41 ± 0.03 mm)

Minimum permissible diameter . . . . 3.593 in. (91.26 mm)

Diameter of bearing surfaces (journals) for the connecting rods [.050 in. (1.27 mm) smaller than the original size] . . . . 3.574 ± .001 in. (90.78 ± 0.03 mm)

Minimum permissible diameter . . . . 3.568 in. (90.63 mm)

Maximum permissible difference from round bearing surface (journal) . . . . .005 in. (0.13 mm)

Clearance between connecting rod bearing and connecting rod bearing surface (journal) of crankshaft . . . . .0029 to .0070 in. (0.074 to 0.178 mm)

Maximum permissible clearance between connecting rod and connecting rod bearing surface (journal) of crankshaft . . . . .012 in. (0.30 mm)

(5) End play for the crankshaft . . . . .012 to .019 in. (0.30 to 0.48 mm)

Maximum permissible end play for the crankshaft . . . . .035 in. (0.89 mm)

(6) Diameter of bearing surfaces (journals) for the main bearings [standard, original size] . . . . 4.260 ± .001 in. (108.20 ± 0.03 mm)

Minimum permissible diameter . . . . 4.251 in. (107.98 mm)

Diameter of bearing surfaces (journals) for the main bearings [.025 in. (0.64 mm) smaller than the original size] . . . . 4.235 ± .001 in. (107.57 ± 0.03 mm)

Minimum permissible diameter . . . . 4.226 in. (107.34 mm)

Diameter of bearing surfaces (journals) for the main bearings [.050 in. (1.27 mm) smaller than the original size] . . . . 4.210 ± .001 in. (106.93 ± 0.03 mm)

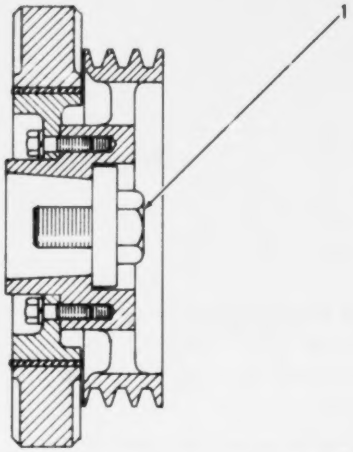
Minimum permissible diameter . . . . 4.201 in. (106.71 mm)

Maximum permissible difference from round bearing surface (journal) . . . . .005 in. (0.13 mm)

Clearance between main bearing and main bearing surface (journal) of crankshaft . . . . .004 to .007 in. (0.10 to 0.18 mm)

Maximum permissible clearance between main bearing and main bearing surface (journal) of crankshaft . . . . .010 in. (0.25 mm)

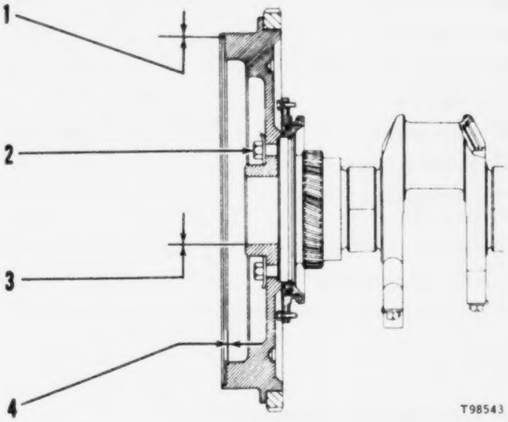
VIBRATION DAMPER



(1) Torque for bolt holding hub and damper on crankshaft .... 600 ± 50 lb.ft. (83.0 ± 6.9 mkg)

Hit bolt with hammer and again tighten bolt to .... 600 ± 50 lb.ft. (83.0 ± 6.9 mkg)

FLYWHEEL



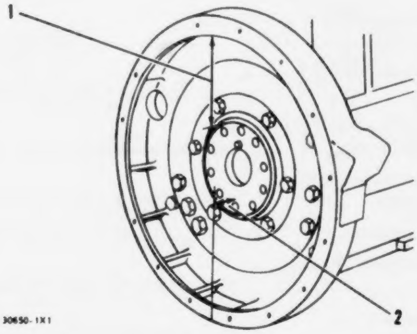
(1) Maximum permissible "runout" (radial eccentricity) off center of bore (total indicator reading) .... .006 in. (0.15 mm)

(2) Torque for bolts holding flywheel to crankshaft .... 280 ± 20 lb.ft. (38.7 ± 2.8 mkg)

(3) Maximum permissible "runout" (radial eccentricity) off center of pilot bore (total indicator reading) .... .005 in. (0.3 mm)

(4) Maximum permissible "runout" (axial eccentricity) of face (total indicator reading) .... .006 in. (0.15 mm)

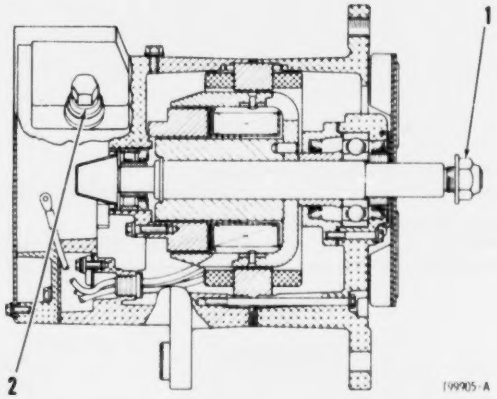
FLYWHEEL HOUSING



(1) Maximum permissible "run out" (radial eccentricity) off center of bore in housing (total indicator reading) .... .012 in. (0.30 mm)

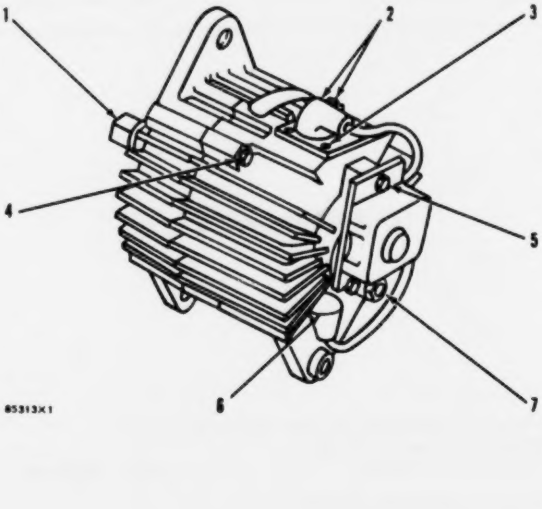
(2) Maximum permissible "run out" (axial eccentricity) of face (total indicator reading) .... .012 in. (0.30 mm)

ALTERNATORS



5S9088 24V 50A (Delco-Remy Number 1117236)

	Circuit	B
	Polarity is negative ground.	
	Speed for testing	5000 rpm
	Rotation can be either direction.	
	Output when cold:	
	Fasten carbon pile to battery to get maximum output	54 A
	Rated output, hot	50 A
	Field current at 24V and 80°F (27°C)	2.5 to 2.9 A
	Voltage regulator:	
	Voltage setting range	26 to 30 V
	Adjust voltage setting to	28 V
	then increase speed to get maximum output	50 A
(1)	Torque for nut	75 ± 5 lb.ft. (10.4 ± 0.7 mkg)
(2)	Torque for output terminal	10 ± 1 lb.ft. (1.4 ± 0.14 mkg)



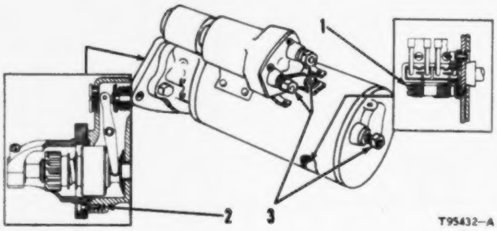
2P1204 24V 19A (Prestolite Number ANB7004)*

	Polarity is negative ground.	
	Rated output at 28V	19 A
	Output at 1500 rpm and 28 V	10 A
	Resistance of the rotor at 77°F (25°C)	18 to 20 ohms
	Current consumption (draw) at 77°F (25°C) and 24 V	1.20 to 1.33 A
(1)	Torque for nut holding pulley	75 ± 5 lb.ft. (10.4 ± 0.7 mkg)
(2)	Torque for nuts for terminals for field and ground	25 to 30 lb.in. (28.8 to 34.6 cm.kg)
(3)	Torque for screws holding terminal plate	12.5 ± 2.5 lb.in. (14.4 ± 2.9 cm.kg)
(4)	Torque for bolts	27.5 ± 2.5 lb.in. (31.7 ± 2.9 cm.kg)
(5)	Torque for bolts holding regulator	47.5 ± 2.5 lb.in. (54.8 ± 2.9 cm.kg)
(6)	Torque for nut for terminal	47.5 ± 2.5 lb.in. (54.8 ± 2.9 cm.kg)
(7)	Torque for nut for positive terminal	225 to 250 lb.in. (259.4 to 288.3 cm.kg)

***Including the 4N5938 Regulator (Prestolite Number VSH-6401B)**

NOTE: FOR TORQUE VALUES NOT GIVEN, SEE THE FIRST PAGE OF SPECIFICATIONS FOR GENERAL TIGHTENING TORQUES

STARTING MOTOR



1P9182 24V (Delco-Remy Number 1109632)

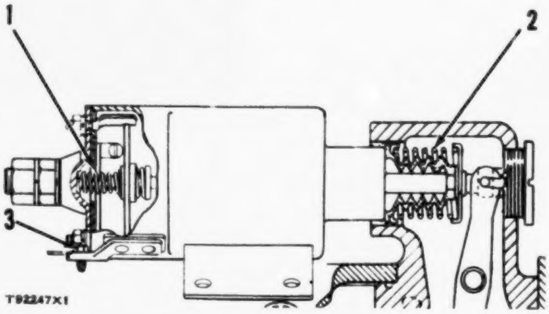
Rotation is clockwise when seen from drive end.

Minimum speed with no load	5500 rpm
Maximum speed with no load	7500 rpm

Current consumption (draw) at no load.

Minimum	127.5A
Maximum	160.1A
Clearance between pinion and housing (pinion clearance)	.36 in. (9.1 mm)
(1) Tension of brush spring	80 oz (2.27 kg)
(2) Torque for screws holding nose housing to lever housing	13 to 17 lb.ft. (1.8 to 2.1 mkg)
3) Torque for terminal nuts	20 to 25 lb.ft. (2.8 to 3.5 mkg)

STARTER SOLENOID



1P9181 24V (Delco-Remy Number 1115526)

Current consumption (draw):

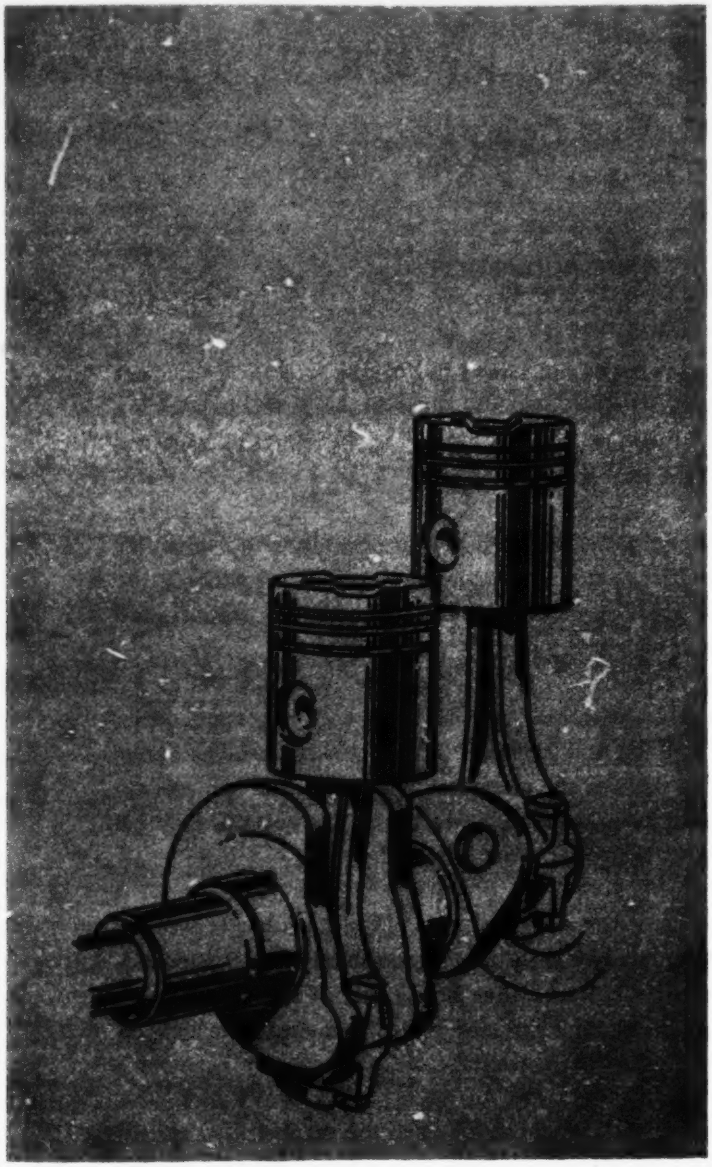
Current at 20V	**40 to 45.5 A**
Current at 20 to 24V	**40 to 54.6 A**

(1) 4M1815 Spring for contact release:

Length under test force	**.42 in. (10.7 mm)**
Test force	**8.5 to 9.5 lb. (3.9 to 4.3 kg)**
Free length after test	**.83 ± .015 in. (21.1 ± 0.38 mm)**
Outside diameter	**.875 ± .010 in. (22.23 ± 0.25 mm)**

(2) 9M7609 Spring to return the clutch lever:

Length under test force	**1.56 in. (39.6 mm)**
Test force	**14 ± 5 lb. (6.35 ± 0.23 kg)**
Free length after test	**2.79 in. (70.9 mm)**
Outside diameter	**1.393 ± .015 in. (35.38 ± 0.38 mm)**
) Torque for terminal screws	**16 to 30 lb.in. (18.4 to 35.0 cm.kg)**



SYSTEMS OPERATION
TESTING AND ADJUSTING

D342
VEHICULAR ENGINE

SERIAL NUMBERS
17S1-UP
50V1-UP

INTRODUCTION

This publication has instructions and procedures for the subject on the front cover. The information, specifications, and illustrations in this publication are on the basis of information that was current at the time this issue was written.

Correct operation, maintenance, test and repair procedures will give this product a long service life. Before starting a test, repair or rebuild job, the serviceman must read the respective sections of the Service Manual, and know all the components he will work on.

Your safety, and the safety of others, is at all times very important. When you see this symbol ⊕ or this symbol ⚠ in the manual, you must know that caution is needed for the procedure next to it. The symbols are warnings. To work safely, you must understand the job you do. Read all instructions to know what is safe and what is not safe.

It is very important to know the weight of parts. Do not lift heavy parts by hand. Use a hoist. Make sure heavy parts have a good stability on the ground. A sudden fall can cause an accident. When lifting part of a machine, make sure the machine has blocks at front and rear. Never let the machine hang on a hoist, put blocks or stands under the weight.

When using a hoist, follow the recommendation in the manual. Use correct lift tools as shown in illustrations to get the correct balance of the component you lift. This makes your work safer at all times.

40400X3

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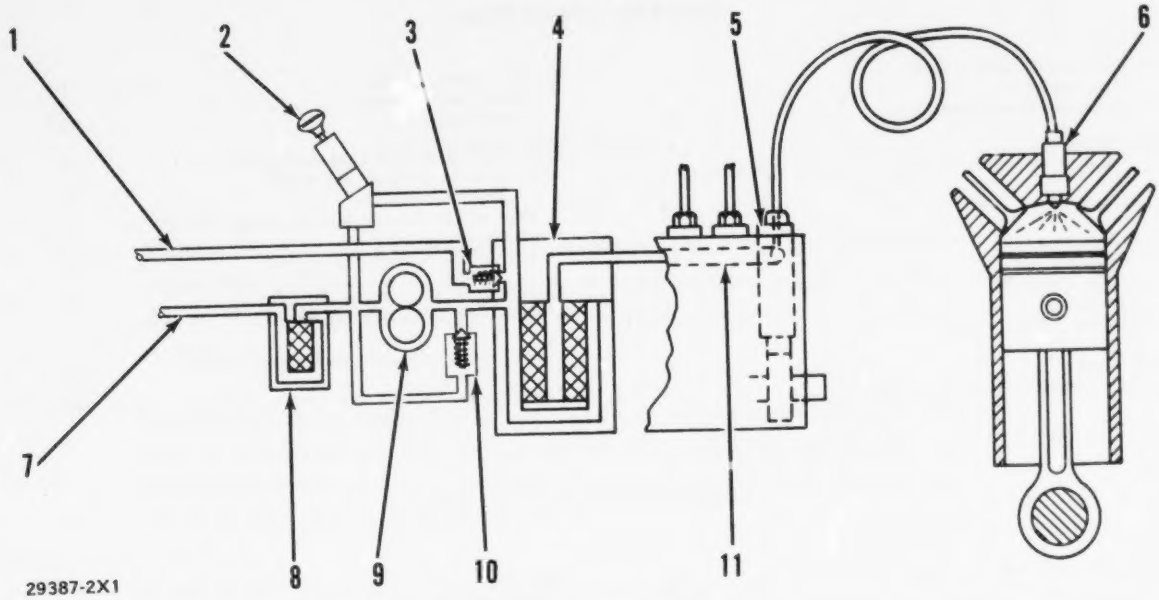
SPECIFICATIONS

NOTE: For Specifications with illustrations, make reference to the Specifications for D342 VEHICULAR ENGINE, Form No. SENR7004. If the Specifications in Form No. SENR7004 are not the same as in the Systems Operation and the Testing and Adjusting, look at the printing date on the back cover of each book. Use the Specifications given with the latest date.

FUEL SYSTEM



SCHEMATIC OF THE FUEL SYSTEM

1. Line for the return of fuel to the fuel tank. 2. Fuel priming pump. 3. Fuel filter bypass valve. 4. Fuel filter. 5. Fuel injection pump. 6. Precombustion chamber. 7. Fuel supply line. 8. Primary fuel filter. 9. Fuel transfer pump. 10. Bypass valve for fuel transfer pump. 11. Fuel manifold.

This engine has a pressure type fuel system. There is a single injection pump and injection valve for each cylinder. The injection pumps (5) are in the pump housing on the right side of the engine. The injection valves are in the precombustion chambers (6) in the top left side of the cylinder head.

The transfer pump (9) sends fuel from the fuel tank to the primary fuel filter (8). The primary fuel filter (8) removes the larger dirt particles from the fuel. Fuel goes from the primary fuel filter (8) to the fuel filter (4). The fuel filter (4) removes the smaller dirt particles from the fuel. Fuel goes from the fuel filter (4) to the fuel manifold (11) in the pump housing. This manifold is the source of fuel supply for each injection pump (5). The injection pumps (5) send fuel through high pressure fuel lines to the injection valves. The injection valves change the fuel to the correct fuel characteristic (spray pattern) for good combustion in the cylinders.

The transfer pump (9) can supply more fuel than is necessary for injection, so a bypass valve (10) is used to control the pressure of the fuel in the fuel system.

An air vent valve in the fuel system is used to remove air from the fuel system. Air is removed by opening the air vent valve and putting pressure to the fuel system with the priming pump (2). Put pressure to the fuel system until a flow of fuel, free of air bubbles, comes from the vent line.

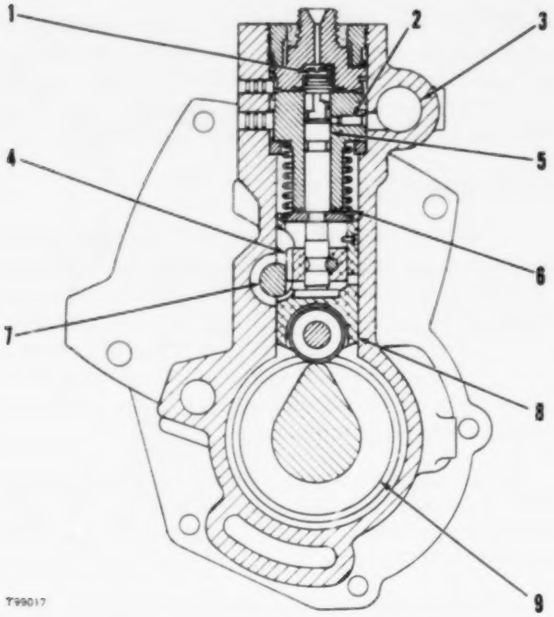
FUEL INJECTION PUMP OPERATION

The injection pump plunger (5) and lifter assembly (8) are lifted by the cam on camshaft (9) and make a full stroke every time. The force of the spring (6) holds the lifter assembly (8) against the cam of the camshaft (9).

Fuel from fuel manifold (3) goes through inlet passage (2), in the barrel and then into the chamber above the plunger (5). During injection, the camshaft cam moves plunger (5) up in the barrel. This movement of plunger (5) closes inlet passage (2) and pushes the fuel out past the check valve (1) through the fuel lines to the injection valves.

Injection starts when the top of the plunger (5) goes past and closes the inlet port (2). The point of injection is in relation to crankshaft position and is controlled by the lifter assembly (8) thickness. A thicker lifter assembly (8) makes the point of injection sooner and a thinner lifter assembly (8) makes the point of injection later.

The amount of fuel sent by the pump per stroke of the plunger (5) is changed by turning the plung-

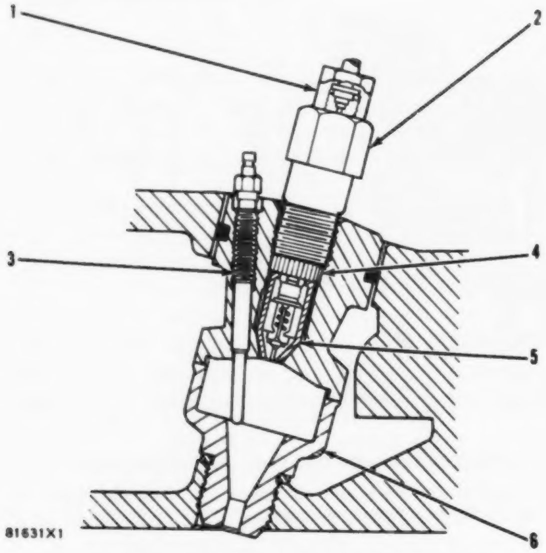


CROSS SECTION OF THE HOUSING FOR THE FUEL INJECTION PUMPS

1. Check valve. 2. Inlet passage in pump barrel. 3. Fuel manifold. 4. Gear segment. 5. Pump plunger. 6. Spring. 7. Fuel rack. 8. Lifter assembly. 9. Camshaft.

er (5) in the barrel. Governor action moves the rack (7) which turns the pump gear segment (4) on the bottom of the plunger (5).

FUEL INJECTION VALVE



CROSS SECTION OF FUEL INJECTION VALVE

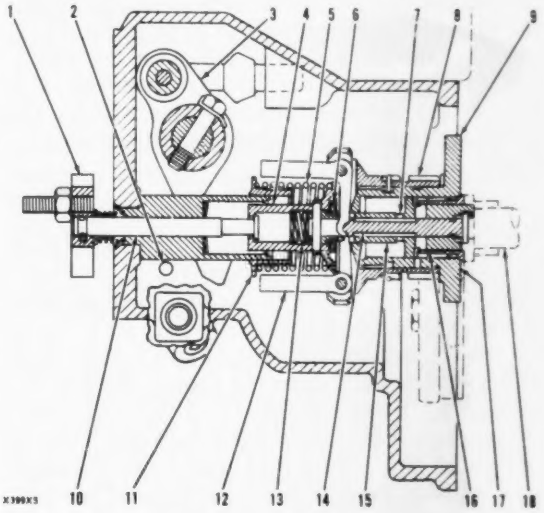
1. Fuel injection line. 2. Nut. 3. Glow plug. 4. Body. 5. Nozzle assembly. 6. Precombustion chamber.

High pressure fuel from the injection pumps goes through the fuel injection lines to the fuel injection valves. As this high pressure fuel goes into the nozzle assembly (5), the check valve in the nozzle assembly opens and the fuel goes into the precombustion chamber (6). The injection valve changes the fuel to the correct fuel characteristics (spray pattern) for good combustion in the cylinders.

HYDRA-MECHANICAL GOVERNOR

The governor control is connected to the control lever assembly on the engine governor. The governor controls the amount of fuel needed to keep the desired engine rpm (governed rpm).

The governor has governor weights (12) driven by the engine, governor spring (5), valve (14) and piston (15). The valve and piston are connected to fuel rack (18). The pressure oil for the governor comes from the engine oil pump. Pressure oil goes through passage (7) and around sleeve (16). The governor control controls only the compression of governor spring (5). Compression of the spring constantly pushes to give more fuel to the engine. The force of rotation (centrifugal force) of governor weights (12) is constantly pulling to get a reduction of fuel to the engine. When these two forces are in balance, the engine runs at the desired rpm.



CROSS SECTION OF THE HYDRA-MECHANICAL GOVERNOR

1. Collar. 2. Speed limiter plunger. 3. Lever assembly. 4. Seat. 5. Governor spring. 6. Thrust bearing. 7. Oil passage. 8. Drive gear for weight assembly. 9. Cylinder. 10. Bolt. 11. Spring seat. 12. Governor weights. 13. Spring. 14. Valve. 15. Piston. 16. Sleeve. 17. Oil passage. 18. Fuel rack.

The governor valve is shown here in the position when the force of rotation of the governor weights and the force of the governor spring are in balance.

When there is an increase in engine load, there is a decrease in engine rpm and the rotation of governor weights (12) is slower. (The governor weights will move toward each other.) Governor spring (5) moves valve (14) forward. When valve (14) moves forward, an oil passage around valve (14) opens to pressure oil. Oil then flows through passage (7) and fills the chamber behind piston (15). This oil pushes the piston and rack forward to give more fuel to the engine. Engine rpm goes up until the force of rotation of the governor weights is large enough to be in balance with the force of the governor spring.

When there is a reduction in engine load, there is an increase in engine rpm and the rotation of governor weights (12) is faster. This moves valve (14) backwards letting the oil behind piston (15) go through an open passage at the rear of the piston. The pressure oil between sleeve (16) and piston (15) then pushes the piston and fuel rack backwards. There is then a reduction in the amount of fuel to the engine. Engine rpm goes down until the force of rotation of the governor weights is in balance with the force of the governor spring. When these two forces are in balance, the engine will run at the desired rpm (governed rpm).

When engine rpm is at LOW IDLE, a plunger with pressure from a spring in lever assembly (3) comes in contact with a shoulder on the adjustment screw for low idle. To stop the engine, pull back on the governor control. This will let the plunger move over the shoulder on the adjustment screw.

When the governor control is moved to the position to start the engine, plunger (2) of the speed limiter puts a restriction on the movement of lever assembly (3). A small amount of force from spring (13) will move fuel rack (18) to give a little more fuel for engine start. With the engine running, the rotation of governor weights (12) will put spring (13) in compression and cause fuel rack (18) to move back. (Spring (13) is extended only at engine start.) After oil pressure of the engine gets to a safe level, plunger (2) of the speed limiter moves back (out of the way) and the governor control can be moved to cause an increase in engine rpm.

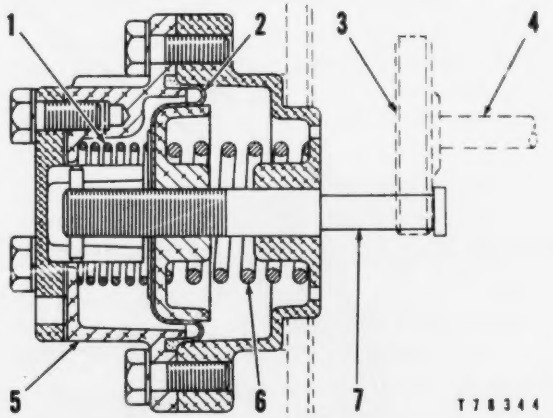
Oil from the engine gives lubrication to the governor weight bearing. The other parts of the governor get lubrication from oil thrown by the weights and other parts. Oil from the governor runs back into the housing for the fuel injection pumps.

FUEL RATIO CONTROL

An air line connects the air inlet manifold to the fuel ratio control. This air line gives the fuel ratio control an indication of the amount of air flowing through the inlet manifold. This lets the fuel ratio control keep the movement of the fuel rack in relation to the air available in the inlet manifold. With the correct air to fuel ratio in the cylinders exhaust smoke is kept to a minimum.

Collar (3) mechanically connects to the fuel rack with governor bolt (4). Bolt assembly (7) goes through a groove in collar (3) and the head of bolt assembly (7) fits behind collar (3).

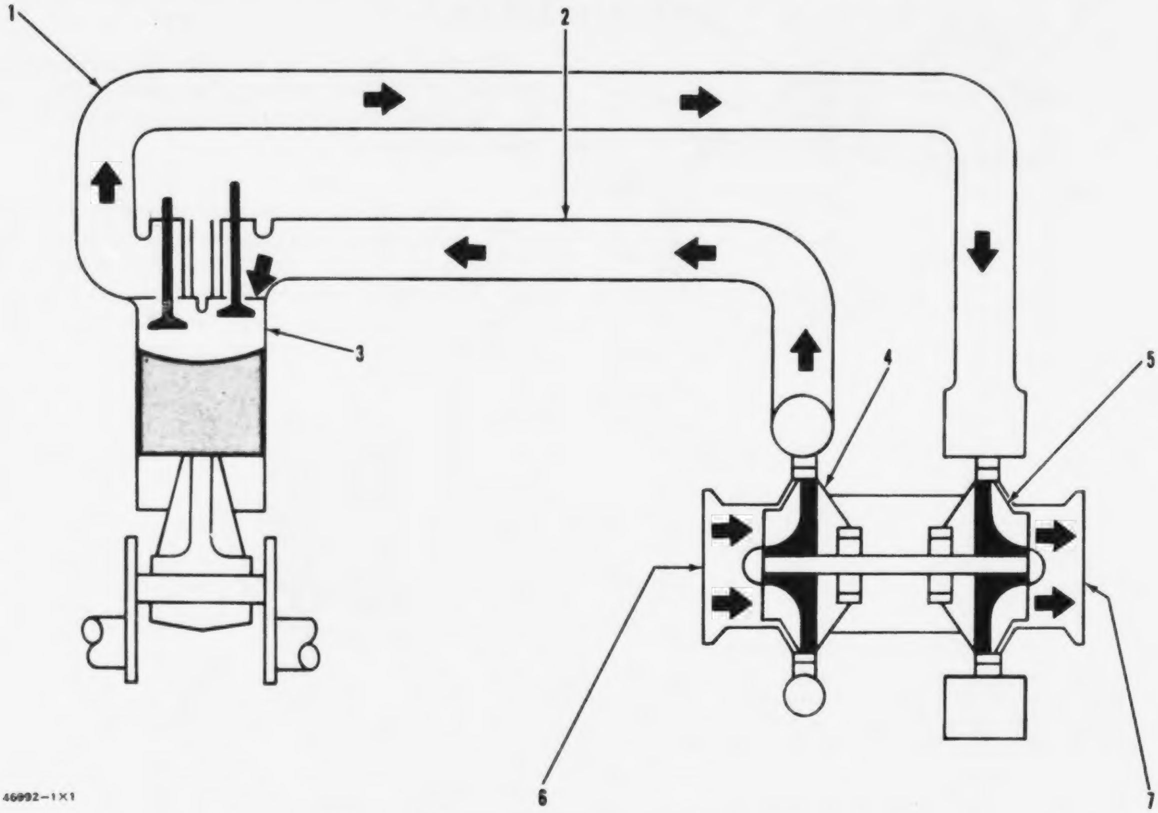
When the operator moves the governor control to make the engine rpm go faster, the governor spring will move collar (3) into contact with the head of bolt assembly (7). Bolt assembly (7) causes a restriction in the movement of collar (3) and bolt (4) until spring (1) and the turbocharger boost of air pressure inside housing (5) causes diaphragm (2), spring (6) and bolt assembly (7) to remove the restriction to collar (3) and bolt (4). This permits the fuel rack to move giving more fuel to the cylinders as the turbocharger boost of air pressure goes higher along with faster engine rpm.



CROSS SECTION OF THE FUEL RATIO CONTROL

1. Spring. 2. Diaphragm. 3. Collar. 4. Bolt. 5. Housing. 6. Spring. 7. Bolt assembly.

AIR INLET AND EXHAUST SYSTEM



AIR INLET AND EXHAUST SYSTEM

1. Exhaust manifold. 2. Inlet manifold. 3. Engine cylinder. 4. Turbocharger impeller. 5. Turbocharger turbine wheel. 6. Air inlet. 7. Exhaust outlet.

The air inlet and exhaust system components are: air cleaner, inlet manifold, cylinder head, valves and valve system components, exhaust manifold, turbocharger, and muffler.

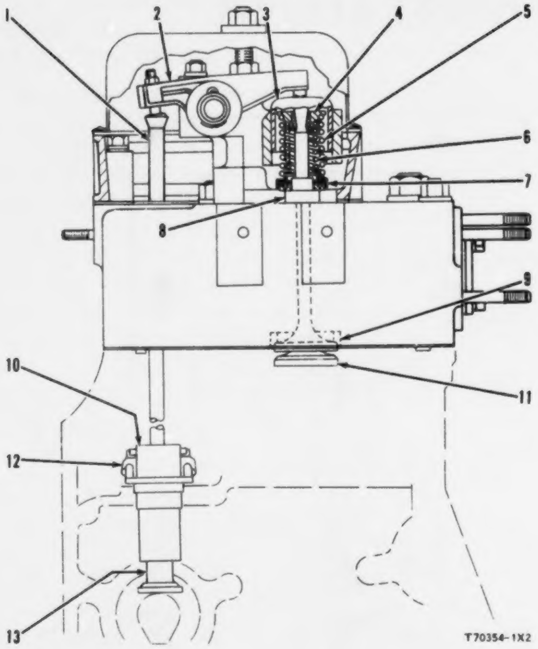
The air cleaner cleans the air before it gets into the turbocharger and inlet manifold. The turbocharger gives air boost to the inlet air for the engine. Changes in load on the engine and the injection of fuel will cause a change in rpm of the turbocharger turbine wheel and impeller. When the load on the engine goes up the rpm of the turbocharger will increase to give more air to the engine.

VALVES AND VALVE MECHANISM

The valves and valve mechanism control the flow of air and exhaust gases in the cylinder during engine operation.

The intake and exhaust valves are opened and closed by movement of these components: crankshaft, camshaft, valve lifters (cam followers), push rods, rocker arms, and valve springs. Rotation of the crankshaft causes rotation of the camshaft. The camshaft gear is driven by, and timed to, a gear on the front of the crankshaft. When the camshaft turns, the cams on the camshaft also turn and cause the valve lifters (cam followers) to go up and down. This movement makes the push rods move the rocker arms. The movement of the rocker arms will make the intake and exhaust valves in the cylinder head to open and close according to the firing order (injection sequence) of the engine. Two valve springs for each valve help to hold the valves in the closed position.

Valve rotators cause the valves to have rotation while the engine is running. This rotation of the valves keeps the deposit of carbon on the valves to a minimum and gives the valves longer service life.



VALVES AND VALVE MECHANISM

1. Push rod. 2. Rocker arm. 3. Sleeve. 4. Retainer. 5. Outer spring. 6. Inner spring. 7. Valve rotator. 8. Valve bushing (valve guide). 9. Insert. 10. Guide for valve lifter. 11. Valve. 12. Yoke. 13. Valve lifter (cam follower).

TURBOCHARGER

The turbocharger is installed near the center of the exhaust manifold. All the exhaust gases from the engine go through the turbocharger.

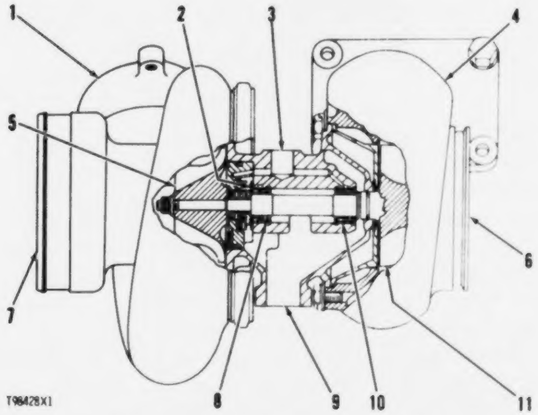
The exhaust gases go through the blades of the turbine wheel. This causes the turbine wheel and compressor wheel to turn.

Clean inlet air from the air cleaner is pulled through the air inlet of the compressor housing by the turning compressor wheel. The compressor wheel causes a compression of the air. The air then goes to the inlet manifold of the engine.

When the load on the engine goes up, more fuel is put into the engine. This makes more exhaust gases and will cause the turbine and compressor wheels of the turbocharger to turn faster. As the turbocharger turns faster it gives more inlet air and makes it possible for the engine to burn more fuel and will give the engine more power.

Maximum rpm of the turbocharger is controlled by the rack setting, the high idle speed setting, and the "altitude" (height above sea level) at which the engine is operated.

⚠ WARNING: If the rack setting or the high idle speed is higher than the setting in the book RACK SETTING INFORMATION for the "altitude" (height above sea level) at which the engine is operated, there can be damage to the engine or to parts of the turbocharger.



CROSS SECTION OF TURBOCHARGER

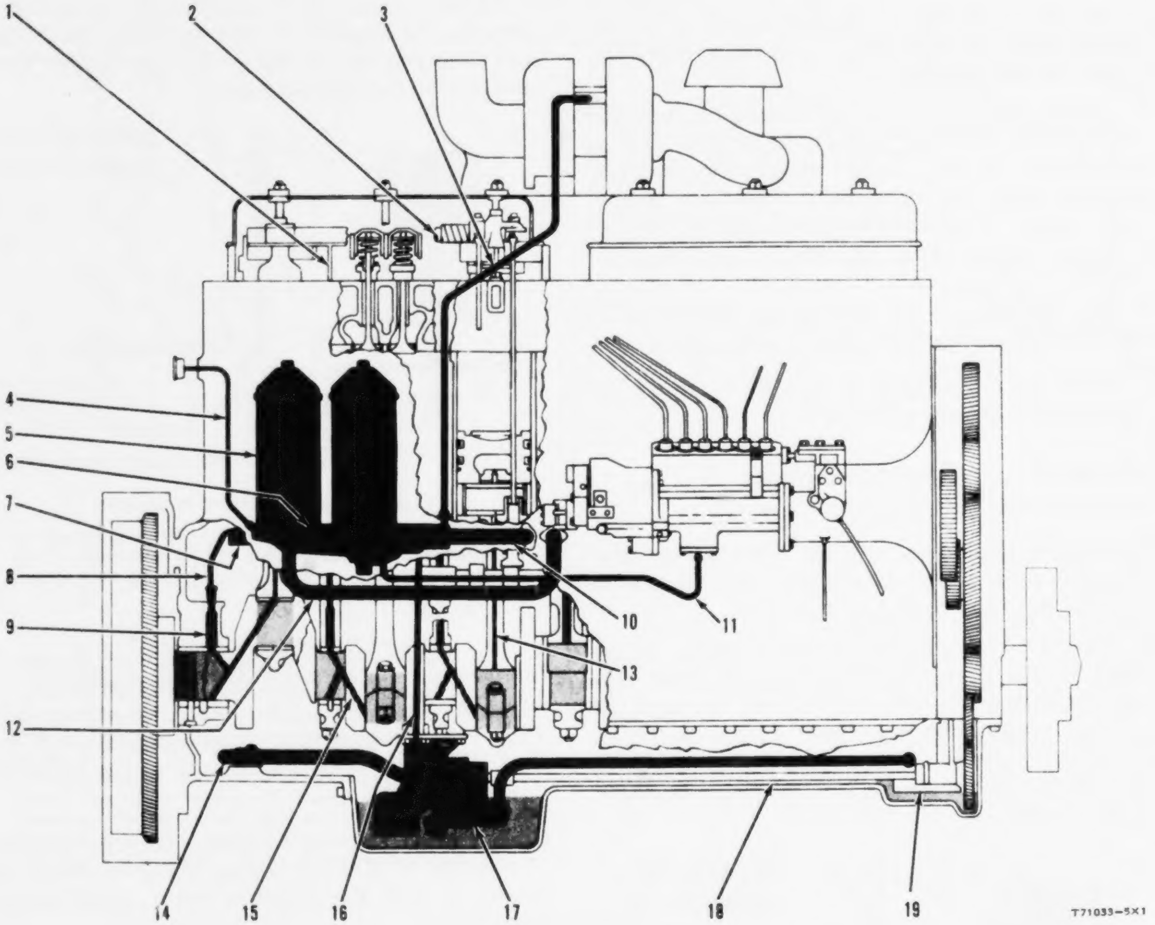
1. Compressor housing. 2. Thrust bearing. 3. Lubrication inlet port. 4. Turbine housing. 5. Compressor wheel. 6. Exhaust outlet. 7. Air inlet. 8. Bearing. 9. Lubrication outlet port. 10. Bearing. 11. Turbine wheel.

The bearings for the turbocharger use engine oil under pressure for lubrication. The oil comes in through the oil inlet port (3) and goes through passages in the center section for lubrication of the bearings (8 and 10). Oil from the turbocharger goes out through the oil outlet port (9) in the bottom of the center section and goes back to the engine lubrication system.

The adjustment of the fuel rack is done at the factory for a specific engine application. The turbocharger and governor housing are sealed to prevent changes in the adjustment of the rack setting and the high idle speed.

LUBRICATION SYSTEM

(DOUBLE OIL FILTER)



LUBRICATION SYSTEM COMPONENTS

1. Oil tube from oil manifold to rear rocker arm shaft (similar tube to front rocker arm shaft). 2. Rocker arm shaft. 3. Oil supply line to turbocharger. 4. Tube for oil pressure gauge. 5. Oil filters (two). 6. Oil filter base. 7. Oil manifold. 8. Tube. 9. Passage to main bearing. 10. Tube to oil cooler. 11. Tube from oil filter base to housing for the fuel injection pumps. 12. Tube from oil cooler. 13. Passage in connecting rod. 14. Rear scavenger suction bell. 15. Passage in crankshaft. 16. Passage from oil pump to oil filter base. 17. Oil pump (two section). 18. Oil pump drive shaft. 19. Front scavenger suction bell.

FLOW OF OIL THROUGH THE ENGINE
(Normal Operation)

The lubrication system uses a two section oil pump (17). The oil pump is in the oil pan and is driven by drive shaft (18) from the timing gears. Oil returns to the center of the oil pan through suction bells (14 and 19).

Oil is sent from the oil pan by the oil pump (17) through passage (16) to oil filter base (6). Oil from the oil filter base goes through tube (10) to the oil cooler, (on the left side of the engine). Oil goes through the oil cooler from front to rear and returns to the filter base through tube (12). From the oil filter base the oil goes through the oil filters (5) and to the oil manifold (7).

A turbocharger lubrication valve, oil cooler bypass valve, and oil filter bypass valve are in the oil filter base. See the subject, FLOW OF OIL THROUGH THE OIL COOLER AND OIL FILTERS.

Oil is sent from the oil manifold through tubes (8) and passage (9) to each main bearing for the crankshaft.

Passages (15) send oil from the main bearings to the bearings for the connecting rods. Passages (13) in the connecting rods give lubrication oil for the piston pins and for the cooling of the piston.

A tube from the oil manifold gives oil to the timing gears. See the subject, LUBRICATION FOR THE TIMING GEARS.

Inside passages and tubes (1) send oil from the oil manifold to rocker arm shaft (2). This oil gives lubrication to the rocker arms, valve bushings (guides), push rods, and valve lifters (cam followers). Tube (11) sends oil to the housing for the fuel injection pumps. Tube (4) sends oil to the gauge for the oil pressure.

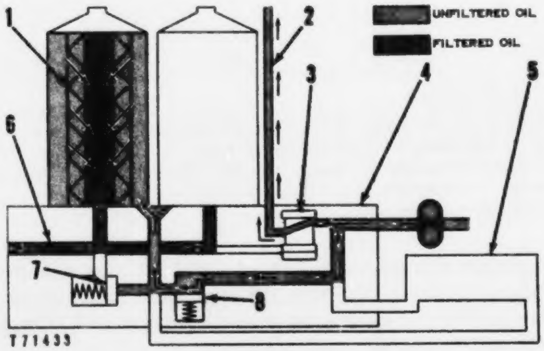
The bearings for the camshaft get lubrication by oil thrown by other parts (splash lubrication).

After the oil has given lubrication to the engine, it returns to the engine oil pan.

FLOW OF OIL THROUGH THE OIL COOLER AND OIL FILTERS

Oil filter bypass valve (7), oil cooler bypass valve (8), and turbocharger lubrication valve (3) are in the oil filter base.

When the oil is cold (when the engine is first started), the bypass valve for the oil cooler will open. Oil from the oil pump is sent through the opened bypass valve for the oil cooler to the oil filters (1). Oil goes through the oil filters and on to passage (6) to the oil manifold to give lubrication to the engine.



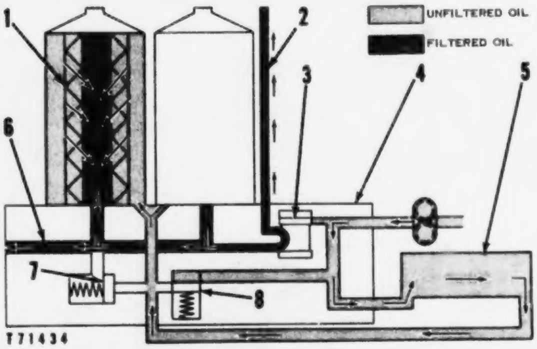
FLOW OF OIL (COLD OIL)

1. Oil filters (two). 2. Oil supply line for turbocharger. 3. Turbocharger lubrication valve. 4. Oil filter base. 5. Oil cooler. 6. Passage to oil manifold. 7. Oil filter bypass valve. 8. Oil cooler bypass valve.

As the temperature of the oil goes up, the bypass valve for the oil cooler will close and the oil will go through oil cooler (5) and then to the oil filters.

When the engine is started, the lubrication valve for the turbocharger will be open. The oil from the oil pump goes through line (2) to the turbocharger.

As the pressure of the oil through the oil filters goes up, the lubrication valve for the turbocharger will close and the oil will go through the oil filters and then to the turbocharger.



FLOW OF OIL (NORMAL OPERATION)

1. Oil filters (two). 2. Oil supply line for turbocharger. 3. Turbocharger lubrication valve. 4. Oil filter base. 5. Oil cooler. 6. Passage to oil manifold. 7. Oil filter bypass valve. 8. Oil cooler bypass valve.

The bypass valve for the oil filters will open if the oil filters have a restriction. This permits the oil to go from the oil pump directly to passage (6). Only clean oil goes to the engine, unless the filters have a restriction or the viscosity of the oil is too high.

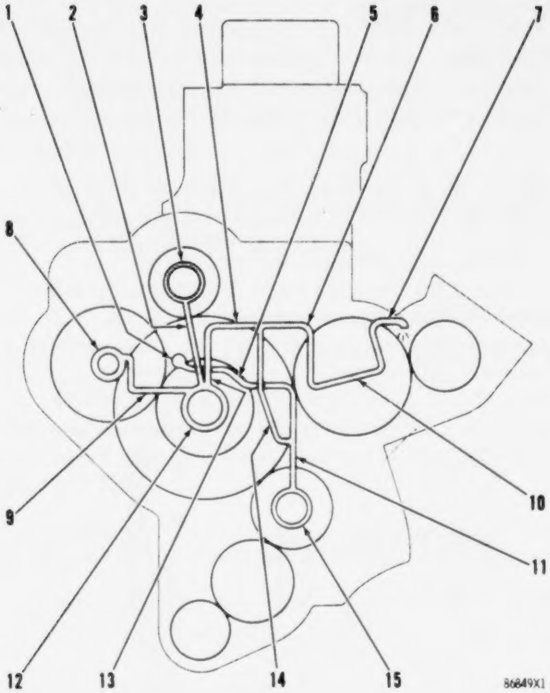
The bypass valves (7 and 8) make it possible for the engine to have lubrication if the oil filters, oil cooler, or both the oil filters and oil cooler have a restriction.

LUBRICATION FOR THE TIMING GEARS

Oil with pressure comes from the oil manifold (1) through tube (14) to passage (11), to the front bearing for the crankshaft (15) and to the tube (14).

Oil goes from tube (14) to tube (4) which gives a supply of oil to the camshaft bearing (12). Oil from this bearing goes through passage (9) to give lubrication oil to accessory drive shaft bearing (8). Oil from bearing (12) also goes through the camshaft and up through passage (2) to the bearing for the power take-off shaft (3).

Oil from tube (14) also goes through tube (6), passage (10) and tube (7) to give lubrication oil to the water pump gear.

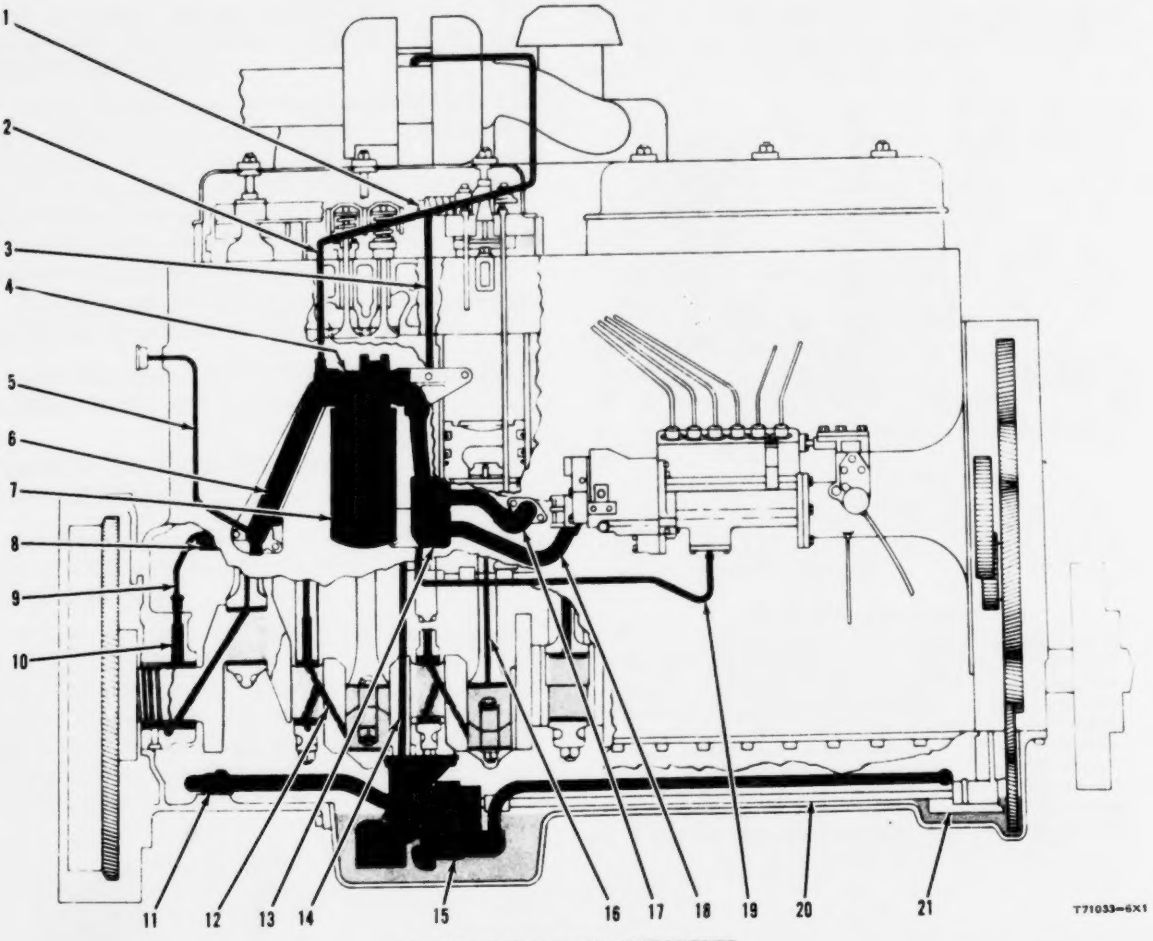


TIMING GEAR LUBRICATION

1. Oil manifold. 2. Passage from camshaft bearing to bearing for power take-off shaft. 3. Bearing for power take-off shaft. 4. Tube to camshaft bearing. 5. Tube from oil manifold to supply for other passages and tubes. 6. Tube to passage (10). 7. Tube to water pump gear. 8. Accessory drive shaft bearing. 9. Passage from camshaft bearing to accessory drive shaft bearing. 10. Passage to tube (7). 11. Passage to front bearing for crankshaft. 12. Bearing for camshaft. 13. Passage from tube (4) to camshaft bearing. 14. Tube from main supply. 15. Front bearing for crankshaft.

LUBRICATION SYSTEM

(SINGLE OIL FILTER)



LUBRICATION SYSTEM COMPONENTS

1. Rocker-arm shaft. 2. Oil line to the turbocharger. 3. Oil tube from the oil manifold to the rear rocker arm shaft (similar tube to the front rocker arm shaft). 4. Oil filter base. 5. Tube for the oil pressure gauge. 6. Outlet for the oil filter. 7. Oil filter. 8. Oil manifold. 9. Tube. 10. Passage to the main bearings. 11. Rear suction bell. 12. Passage in the crankshaft. 13. Inlet for the oil filter and bypass valve for the oil cooler. 14. Passage from oil pump to inlet for oil filter. 15. Oil pump (two section). 16. Passage in the connecting rod. 17. Tube from oil cooler to inlet for oil filter. 18. Tube to oil cooler. 19. Tube from inlet for the oil filter to the fuel injection pump housing. 20. Drive shaft for the oil pump. 21. Front suction bell.

FLOW OF OIL THROUGH THE ENGINE
(Normal Operation)

The lubrication system uses a two section oil pump (15). The oil pump is in the oil pan and is driven by the drive shaft (20) from the timing gears. Oil returns to the center of the oil pan through suction bells (11 and 21). Oil is sent from the oil pan by the oil pump (15) through passage (14) to the inlet for the oil filter (13). Oil from the inlet for the oil filter (13) goes through the tube (18) to the oil cooler (on the left side of the engine). Oil goes through the oil cooler from front to rear and returns to the inlet for the oil filter (13) through tube (17). From the inlet for the oil filter (13) oil goes through the filter (7) and into the oil manifold (8) through the outlet for oil filter (6).

There is a bypass valve for the oil cooler in the inlet for the oil filter (13) and a bypass valve for the oil filter in the oil filter base (4). See the subject, FLOW OF OIL THROUGH THE OIL COOLER AND OIL FILTER.

Oil is sent from the oil manifold (8) through tubes (9) and passages (10) to each main bearing for the crankshaft. Passages (12) send oil from the main bearings to the bearings for the connecting rods. Passages in the connecting rods (16) give lubrication oil for the piston pins and for cooling the pistons.

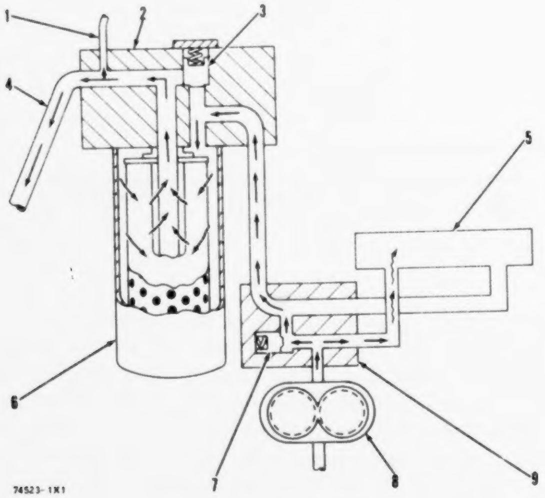
A tube from the oil manifold gives oil to the timing gears. See the subject, LUBRICATION FOR THE TIMING GEARS.

Inside passages and tubes (3) send oil from the oil manifold to the rocker arm shaft (1). This oil gives lubrication to the rocker arms, valve bushings (guides), push rods and valve lifters (cam followers). Tube (19) sends oil to the housing for the fuel injection pumps. Tube (5) sends oil to the gauge for the oil pressure. Oil is sent to the turbocharger by tube (2).

The bearings for the camshaft get lubrication by oil thrown from other parts (splash lubrication).

After the oil has given lubrication to the engine it returns to the engine oil pan.

FLOW OF OIL THROUGH THE OIL COOLER AND OIL FILTER

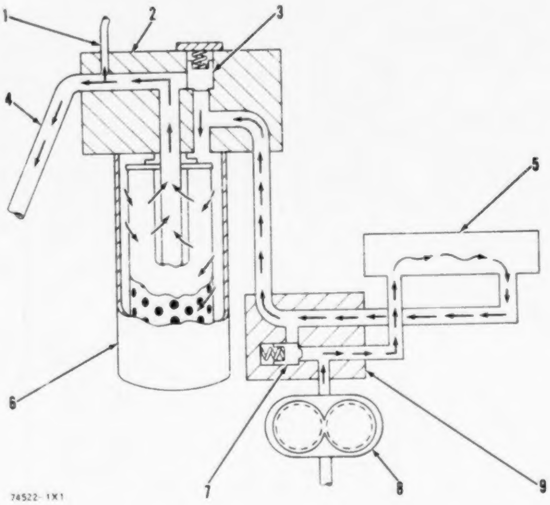


FLOW OF OIL (COLD OIL)

1. Tube to turbocharger. 2. Oil filter base. 3. Oil filter bypass valve. 4. Passage to oil manifold. 5. Oil cooler. 6. Oil filter. 7. Bypass valve for the oil cooler. 8. Oil pump. 9. Inlet to oil filter.

The oil filter bypass valve (3) is in the oil filter base (2) and the oil cooler bypass valve (7) is in the inlet for the oil filter (9).

When the oil is cold (when the engine is first started) the bypass valve (7) for the oil cooler will open. Oil from the oil pump is sent through the opened bypass valve for the oil cooler to the oil filter (6). Oil goes through the oil filter and on through the passage (4) to the oil manifold to give lubrication to the engine. Oil also goes through tube (1) to give lubrication to the turbocharger.



FLOW OF OIL (NORMAL OPERATION)

1. Tube to turbocharger. 2. Oil filter base. 3. Oil filter bypass valve. 4. Passage to oil manifold. 5. Oil cooler. 6. Oil filter. 7. Bypass valve for the oil cooler. 8. Oil pump. 9. Inlet to the oil filter.

As the temperature for the oil goes up (normal operation), the bypass valve for the oil cooler (7) will close and the oil will go through the oil cooler (5) and then to the oil filter (6).

The bypass valve for the oil filter (3) will open if the oil filter has a restriction. This permits the oil from the oil pump to go directly to passage (4) and tube (1). Only clean oil goes to the engine unless the filter has a restriction or the viscosity of the oil is too high.

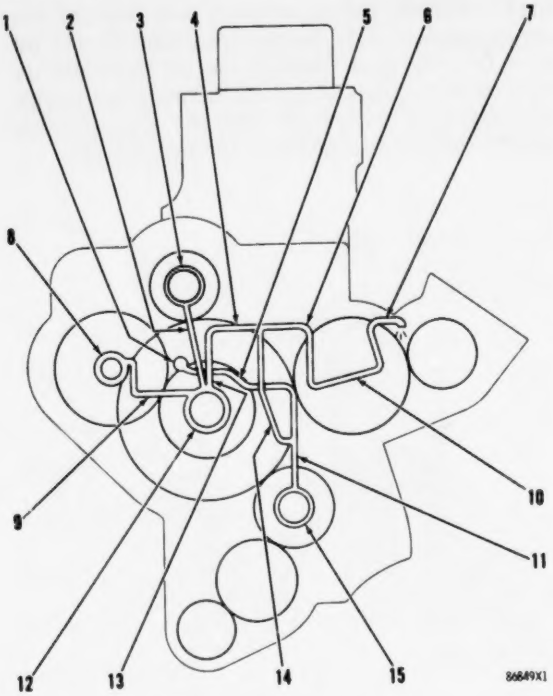
The bypass valves (3 and 7) make it possible for the engine to have lubrication if the oil filter, oil cooler or both have a restriction.

LUBRICATION FOR THE TIMING GEARS

Oil with pressure comes from the oil manifold (1) through tube (14) to passage (11), to the front bearing for the crankshaft (15) and to the tube (14).

Oil goes from tube (14) to tube (4) which gives a supply of oil to the camshaft bearing (12). Oil from this bearing goes through passage (9) to give lubrication oil to accessory drive shaft bearing (8).

LUBRICATION SYSTEM
(SINGLE OIL FILTER)



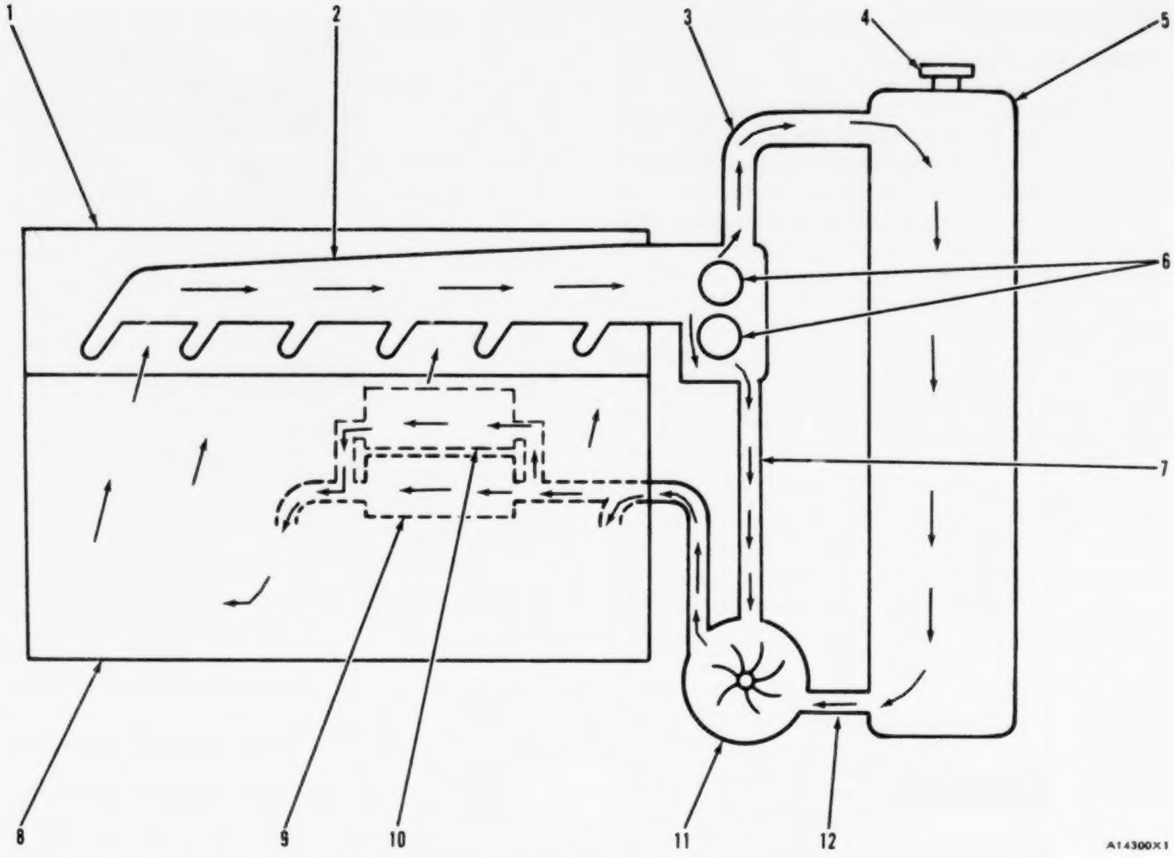
TIMING GEAR LUBRICATION

1. Oil manifold. 2. Passage from camshaft bearing to bearing for power take-off shaft. 3. Bearing for power take-off shaft. 4. Tube to camshaft bearing. 5. Tube from oil manifold to supply for other passages and tubes. 6. Tube to passage (10). 7. Tube to water pump gear. 8. Accessory drive shaft bearing. 9. Passage from camshaft bearing to accessory drive shaft bearing. 10. Passage to tube (7). 11. Passage to front bearing for crankshaft. 12. Bearing for camshaft. 13. Passage from tube (4) to camshaft bearing. 14. Tube from main supply. 15. Front bearing for crankshaft.

Oil from bearing (12) also goes through the camshaft and up through passage (2) to the bearing for the power take-off shaft (3).

Oil from tube (14) also goes through tube (6), passage (10) and tube (7) to give lubrication oil to the water pump gear.

COOLING SYSTEM



FLOW OF COOLANT IN RADIATOR COOLING SYSTEM

1. Cylinder head. 2. Water manifold. 3. Radiator inlet line. 4. Relief valve. 5. Radiator. 6. Temperature regulators. 7. Bypass line. 8. Cylinder block. 9. Engine oil cooler. 10. Transmission oil cooler. 11. Water pump. 12. Radiator outlet line.

Water pump (10) is gear driven by the engine timing gears. The water pump gets coolant from the bottom tank of radiator (5) and sends some of the coolant into cylinder block (8). The remainder of the coolant goes through oil cooler (9), to cool the oil for lubrication of the engine, and then into the cylinder block.

The coolant then goes around the cylinder block, around the cylinder liners and up through the water ferrules and directors into cylinder head (1).

Coolant moves through the cylinder head and into water manifold (2). The coolant goes through the water manifold to temperature regulators (6) at the front of the water manifold. If the coolant is cold (cool), the temperature regulators will be closed. The coolant will go through bypass line (7) to the water pump. If the coolant is warm, the temperature regulators will be open and the coolant will go through line (3) and into the top tank of the radiator. Coolant then goes through the core of the radiator to the bottom tank, where it is again sent through the cooling system. A small part of the coolant goes through bypass line (7) when the temperature regulators are open.

Relief valve (4) is used to keep the correct pressure in the cooling system. This pressure keeps a constant supply of coolant to the water pump. If this pressure goes too high, a valve in the relief valve moves (opens) to get a reduction of pressure. When the correct pressure is in the cooling system, the valve in the relief valve moves down (to the closed position).

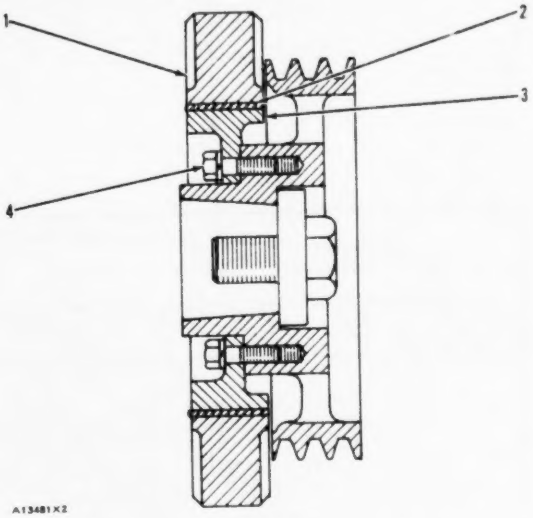
BASIC BLOCK

VIBRATION DAMPER

Rubber Ring Type Damper

The twisting of the crankshaft, due to the regulator power impacts along its length, is called twisting (torsional) vibration. The vibration damper is installed on the front end of the crankshaft. It is used for reduction of torsional vibrations and stops the vibration from building up to amounts that cause damage.

The damper is made of a flywheel ring (1) connected to an inner hub (3) by a rubber ring (2). The rubber makes a flexible coupling between the flywheel ring and the inner hub.



CROSS SECTION OF A VIBRATION DAMPER

1. Flywheel ring. 2. Rubber ring. 3. Inner hub. 4. Bolt.

ELECTRICAL SYSTEM

The electrical system has three separate circuits: the charging circuit, the starting circuit and the low amperage circuit. Some of the electrical system components are used in more than one circuit. The battery (batteries), circuit breaker, ammeter, cables and wires from the battery are all common in each of the circuits.

The charging circuit is in operation when the engine is running. An alternator makes electricity for the charging circuit. A voltage regulator in the circuit controls the electrical output to keep the battery at full charge.

The starting circuit is in operation only when the start switch is activated.

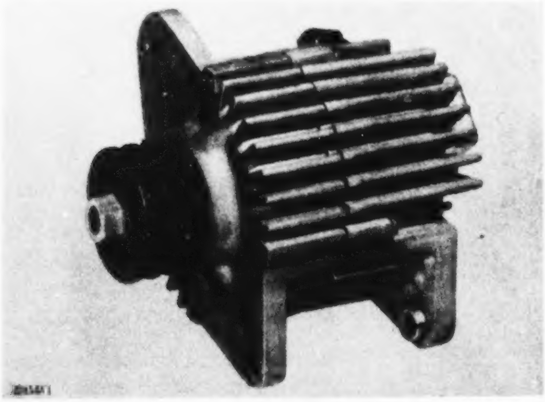
The starting circuit can have a glow plug for each cylinder of the diesel engine. Glow plugs are small heating units in the precombustion chambers. Glow plugs aid ignition of the fuel when the engine is started in cold temperatures.

The low amperage circuit and the charging circuit are both connected to the same side of the ammeter. The starting circuit connects to the opposite side of the ammeter.

SYSTEM COMPONENTS

Alternator (Prestolite) 2P1204

The alternator is driven by two V type belts from the fan pulley. It is a 24 volt, 19 ampere unit with a regulator which has no moving parts (solid state) installed on the side opposite the pulley. The alternator is made up of the following parts: head assembly on the drive end, rotor assembly, stator assembly, rectifier and heat removal assemblies, brush and holder assembly, head assembly on the ring end, and regulator.



2P1204 ALTERNATOR

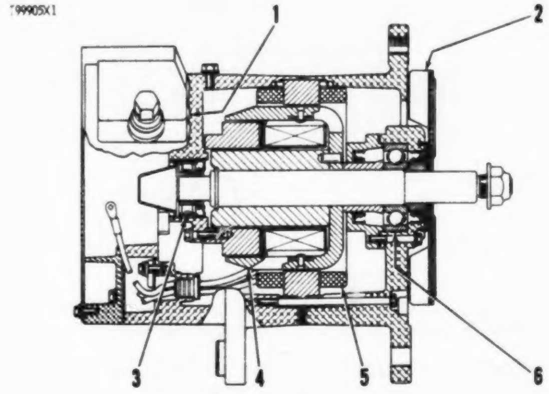
The alternator has diodes which change the alternating currrent (AC) made by the alternator to direct current (DC). This direct current is used to make magnet like lines of force in a space around the stator assembly (field current). The field current is controlled by the regulator.

Alternator (Delco-Remy) 5S9088

The alternator is a three phase, self rectifying charging unit. The regulator for the alternator is part of the alternator. The alternator is driven from the fan pulley by two V type belts.

The only part in the alternator which moves is the rotor. The rotor is held in position by a ball bearing at the drive end and a roller bearing at the rectifier end.

The compartment for the regulator is sealed. The regulator controls the alternator output according to the needs of the battery and the other components in the electrical system.



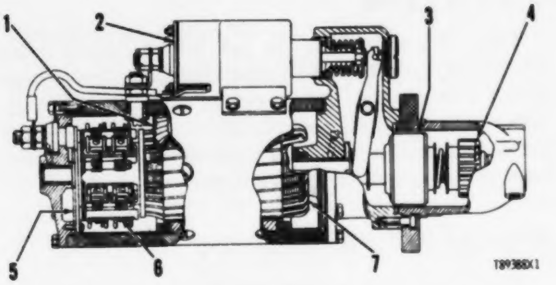
5S9088 ALTERNATOR

1. Regulator. 2. Fan. 3. Roller bearing. 4. Rotor. 5. Stator windings. 6. Ball bearing.

Starting Motor

The starting motor is used to turn the engine flywheel fast enough to get the engine running.

The starting motor has a solenoid. When the start switch is activated, electricity from the electrical system will cause the solenoid (2) to move the starter pinion (4) to engage with the ring gear on the flyhweel of the engine. The starter pinion will engage with the ring gear before the electric contacts in the solenoid close the circuit between the battery and the starting motor. When the start switch is released, the starter pinion will move away from the ring gear of the flywheel.

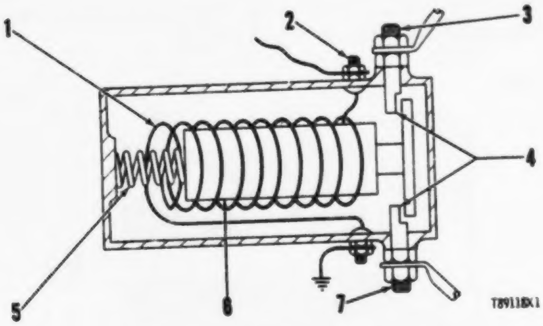


STARTING MOTOR

1. Field. 2. Solenoid. 3. Clutch. 4. Pinion. 5. Commutator. 6. Brush assembly. 7. Armature.

Solenoid

A solenoid is a magnetic switch that uses low current to close a high current circuit. The solenoid has an electromagnet with a core (6) which moves.



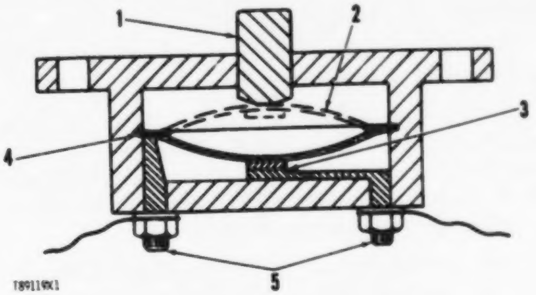
SCHEMATIC OF A SOLENOID

1. Coil. 2. Switch terminal. 3. Battery terminal. 4. Contacts. 5. Spring. 6. Core. 7. Component terminal.

There are contacts (4) on the end of core (6). The contacts are held in the open position by spring (5) that pushes core (6) from the magnetic center of coil (1). Low current will energize coil (1) and make a magnetic field. The magnetic field pulls core (6) to the center of coil (1) and the contacts (4) close.

Circuit Breaker

The circuit breaker is a safety switch that opens the battery circuit if the current in the electrical system goes higher than the rating of the circuit breaker.



CIRCUIT BREAKER SCHEMATIC

1. Reset button. 2. Disc in open position. 3. Contacts. 4. Disc. 5. Battery circuit terminals.

A heat activated metal disc with a contact point completes the electric circuit through the circuit breaker. If the current in the electrical system gets too high, it causes the metal disc to get hot. This heat causes a distortion of the metal disc which opens the contacts and breaks the circuit. A circuit breaker that is open can be reset after it cools. Push the reset button to close the contacts and reset the circuit breaker.

TROUBLESHOOTING

Troubleshooting can be difficult. On the following pages there is a list of possible problems. To make a repair to a problem, make reference to the cause and correction.

This list of problems, causes, and corrections, will only give an indication of where a possible problem can be, and what repairs are needed. Normally, more or other repair work is needed beyond the recommendations in the list.

Remember that a problem is not normally caused only by one part, but by the relation of one part with other parts. This list can not give all possible problems and corrections. The serviceman must find the problem and its source, then make the necessary repairs.

Item	Problem
1.	Engine Will Not Turn When Start Switch Is On.
2.	Engine Will Not Start.
3.	Misfiring or Running Rough.
4.	Stall at Low rpm.
5.	Sudden Changes In Engine rpm.
6.	Not Enough Power.
7.	Too Much Vibration.
8.	Loud Combustion Noise.
9.	Loud Noise (Clicking) From Valve Compartment.
10.	Oil In Cooling System.
11.	Mechanical Noise (Knock) In Engine.
12.	Fuel Consumption Too High.
13.	Loud Noise From Valves or Valve Drive Components.
14.	Little Movement of Rocker Arm and Too Much Valve Clearance.
15.	Valve Rotocoil or Spring Lock is Free.
16.	Oil at the Exhaust.
17.	Little or No Valve Clearance.
18.	Engine Has Early Wear.
19.	Coolant In Lubrication Oil.
20.	Too Much Black or Gray Smoke.
21.	Too Much White or Blue Smoke.
22.	Engine Has Low Oil Pressure.
23.	Engine Uses Too Much Lubrication Oil.
24.	Engine Coolant Is Too Hot.
25.	Starting Motor Does Not Turn.
26.	Alternator Gives No Charge.
27.	Alternator Charge Rate Is Low or Not Regular.
28.	Alternator Charge Too High.
29.	Alternator Has Noise.
30.	Exhaust Temperature Too High.

Problem	Cause	Correction
1. ENGINE CRANKSHAFT WILL NOT TURN WHEN START SWITCH IS ON	Battery Has Low Output	Make Reference to Item 25.
	Wiring or Switches Have Defect	Make Reference to Item 25.
	Starting Motor Solenoid Has A Defect	Make Reference to Item 25.
	Starting Motor Has A Defect	Make Reference to Item 25.
	Inside Problem Prevents Engine Crankshaft From Turning	If the crankshaft can not be turned after disconnecting the driven equipment, remove the fuel nozzles and check for fluid in the cylinders while turning the crankshaft. If fluid in the cylinders is not the problem, the engine must be disassembled to check for other inside problems. Some of these inside problems are bearing seizure, piston seizure, wrong pistons installed in the engine, and valves making contact with pistons.

Problem	Cause	Correction
2. ENGINE WILL NOT START	Slow Cranking Speed	Make Reference to Item 25.
	Dirty Fuel Filter	Install new fuel filter.
	Dirty or Broken Fuel Lines	Clean or install new fuel lines as necessary.
	Fuel Transfer Pump	At starting rpm, the minimum fuel pressure from fuel transfer pump must be 5 psi (0.35 kg/cm^2). If fuel pressure is less than 5 psi (0.35 kg/cm^2), change the fuel filter element. Look for air in the fuel system. If fuel pressure is still low, install a new fuel transfer pump.
	No Fuel To Cylinders	Put fuel in fuel tank. "Prime" (remove the air and/or low quality fuel from the fuel system).
	Bad Quality Fuel	Remove the fuel from the fuel tank. Install a new fuel filter element. Put a good grade of clean fuel in the fuel tank.
	Wrong Fuel Injection Timing	Make adjustment to timing.
3. MISFIRING OR RUNNING ROUGH	Fuel Pressure is Low	Make sure there is fuel in the fuel tank. Look for leaks or bad bends in the fuel line between fuel tank and fuel transfer pump. Look for air in the fuel system. Check fuel pressure. The outlet pressure of the fuel transfer pump must be 32 ± 7 psi (2.25 ± 0.49 kg/cm^2) at full load. If fuel pressure is lower than the above pressure, install a new filter element. If fuel pressure is still low, install a new fuel transfer pump.
	Air in Fuel System	Find the air leak in the fuel system and correct it. If air is in the fuel system it will generally get in on the suction side of fuel transfer pump.

Problem	Cause	Correction
3. MISFIRING OR RUNNING ROUGH (CONT.)	Leak or Break in Fuel Line Between Injection Pump and Injection Valve	Install a new fuel line.
	Wrong Valve Clearance	Make adjustment according to Specifications.
	Defect in Fuel Injection Valve(s) or Injection Pump(s)	Run engine at rpm that gives maximum misfiring or rough running. Then loosen a fuel line nut on the injection valve for each cylinder, one at a time. Find the cylinder where loosening the fuel line nut does not change the way the engine runs. Test the injection pump and injection valve for that cylinder. Install new parts where needed.
	Wrong Fuel Injection Timing	Make adjustment to timing.
4. STALL AT LOW RPM	Fuel Pressure is Low	Make sure there is fuel in the fuel tank. Look for leaks or bad bends in the fuel line between fuel tank and fuel transfer pump. Look for air in the fuel system. Check fuel pressure. The outlet pressure of the fuel transfer pump must be 32 ± 7 psi (2.25 ± 0.49 kg/cm^2) at full load. If fuel pressure is lower than the above pressure, install a new fuel filter element. If fuel pressure is still low, install a new fuel transfer pump.
	Idle rpm Too Low	Make adjustment to governor so idle rpm is the same as given in the book RACK SETTING INFORMATION.
	Defect in Fuel Injection Valve(s)	Install a new fuel injection valve.
	Engine Accessories	Check engine accessories for damage and correct adjustment. If necessary, disconnect the accessories and test the engine.
	Defect in Fuel Injection Pump(s)	Install new parts if needed.

Problem	Cause	Correction
5. SUDDEN CHANGES IN ENGINE SPEED (rpm)	Failure of Governor or Fuel Injection Pump	Look for damaged or broken springs, linkage or other parts. Remove the governor. Check for free travel of the fuel rack. Be sure fuel injection pumps are installed correctly. Check for correct governor spring. Install new parts for those that have damage or defects.
6. NOT ENOUGH POWER	Bad Quality Fuel	Remove the fuel from the fuel tank. Install a new fuel filter element. Put a good grade of clean fuel in the fuel tank.
	Fuel Pressure is Low	Make sure there is fuel in the fuel tank. Look for leaks, or bad bends, in the fuel line between fuel tank and fuel transfer pump. Look for air in the fuel system. Check fuel pressure. The outlet pressure of the fuel transfer pump must be 32 ± 7 psi (2.25 ± 0.49 kg/cm^2) at full load. If fuel pressure is lower than the above pressure, install a new fuel filter element. If fuel pressure is still low, install a new fuel transfer pump.
	Leaks in Air Inlet System	Check the pressure in the air intake manifold. Look for restrictions in the air cleaner.
	Governor Linkage	Make adjustment to get full travel of linkage. Install new parts of those that have damage or defects.
	Wrong Valve Clearance	Make adjustment according to Specifications.
	Defect in Fuel Injection Valve(s) or Fuel Injection Pump(s)	Run engine at rpm that gives maximum misfiring or rough running. Then loosen a fuel line nut on the injection pump for each cylinder, one at a time. Find the cylinder where loosening the fuel line nut does not change the way the engine runs. Test the injection pump and injection valve for that cylinder. Install new parts where needed.
	Wrong Fuel Injection Timing	Make adjustment to timing.
	Rack Setting Too Low	Make reference to the book RACK SETTING INFORMATION.

Problem	Cause	Correction
7. TOO MUCH VIBRATION	Loose Bolt or Nut Holding Pulley or Damper	Tighten bolt or nut.
	Pulley or Damper Has A Defect	Install a new pulley or damper.
	Engine Supports Are Loose, Worn, or Have A Defect	Tighten all mounting bolts. Install new components if necessary.
	Misfiring or Running Rough	Make Reference to Item 3.
8. LOUD COMBUSTION NOISE (SOUND)	Bad Quality Fuel	Remove the fuel from the fuel tank. Install a new fuel filter element. Put a good grade of clean fuel in the fuel tank.
	Defect in Fuel Injection Valve(s)	Install a new fuel injection valve(s).
	Defect in Fuel Injection Pump(s)	Install new fuel injection pump(s).
	Wrong Fuel Injection Timing	Make adjustment to timing.
9. LOUD NOISE (CLICKING) FROM VALVE COMPARTMENT	Broken Valve Spring(s) or Locks	Install new parts where necessary. Broken locks can cause the valve to slide into the cylinder. This will cause much damage.
	Not Enough Lubrication	Check lubrication in valve compartment. There must be a strong flow of oil at engine high rpm, but only a small flow of oil at low rpm. Oil passages must be clean, especially those sending oil to the cylinder head.
	Too Much Valve Clearance	Make adjustment according to Specifications.
10. OIL IN COOLING SYSTEM	Defect In Core of Oil Cooler	Install a new core in the oil cooler.
	Defect in Head Gasket	Install a new head gasket.

Problem	Cause	Correction
11. MECHANICAL NOISE (KNOCK) IN ENGINE	Failure of Bearing For Connecting Rod	Inspect the bearing for the connecting rod and the bearing surface (journal) on the crankshaft. Install new parts where necessary.
	Damaged Timing Gears	Install new parts where necessary.
	Defect in Attachment	Repair or install new components.
12. FUEL CONSUMPTION TOO HIGH	Fuel System Leaks	Replacement of parts is needed at points of leakage.
	Fuel and Combustion Noise (Knock)	Make Reference to Item 3 and Item 6.
	Wrong Fuel Injection Timing	Make adjustment to timing.
13. LOUD NOISE FROM VALVES OR VALVE DRIVE COMPONENTS	Broken Valve Spring(s)	Make replacement of parts with damage.
	Broken Camshaft	Make replacement of parts with damage. Clean engine thoroughly.
14. LITTLE MOVEMENT OF ROCKER ARM AND TOO MUCH VALVE CLEARANCE	Not Enough Lubrication	Check lubrication in valve compartment. There must be a strong flow of oil at engine high rpm, but only a small flow at low rpm. Oil passages must be clean, especially those sending oil to the cylinder head.
	Rocker Arm Worn at Face That Contacts End of Valve	If there is too much wear, install new parts or rocker arms. Make adjustment of valve clearance according to the Specifications.
	End of Valve Stem Worn	If there is too much wear, install new valves. Make adjustment to valve clearance according to Specifications.
	Worn Push Rods	If there is too much wear, install new push rods. Make adjustment of valve clearance according to the Specifications.
	Valve Lifters Worn	If there is too much wear, install new valve lifters. Make adjustment of valve clearance according to the Specifications.
	Broken or Worn Valve Lifters	Install new valve lifters. Check camshaft for wear. Check for free movement of valves or bent valve stem. Clean engine thoroughly. Make adjustment of valve clearance according to Specifications.
	Worn Cams on Camshaft	Check valve clearance. Check for free movement of valves or bent valve stems. Install a new camshaft. Make adjustment of valve clearance according to the Specifications.

Problem	Cause	Correction
15. VALVE ROTOCOIL OR SPRING LOCK IS FREE	Broken Locks	Broken locks can cause the valve to slide into the cylinder. This will cause much damage.
	Broken Valve Spring(s)	Install new valve spring(s).
16. OIL AT THE EXHAUST	Too Much Oil in the Valve Compartment	Look at both ends of the rocker arm shaft. Be sure that there is a plug in each end.
	Worn Valve Guides	Reconditioning of the cylinder head is needed.
	Worn Piston Rings	Inspect and install new parts as needed.
17. LITTLE OR NO VALVE CLEARANCE	Worn Valve Seat or Face of Valve	Reconditioning of cylinder head is needed. Make adjustment of valve clearance according to the Specifications.
18. ENGINE HAS EARLY WEAR	Dirt in Lubrication Oil	Remove dirty lubrication oil. Install a new oil filter element. Put clean oil in the engine.
	Air Inlet Leaks	Inspect all gaskets and connections. Make repairs if leaks are found.
	Fuel Leakage Into Lubrication Oil	This will cause high fuel consumption and low engine oil pressure. Make repairs if leaks are found. Install new parts where needed.
19. COOLANT IN LUBRICATION OIL	Failure of Oil Cooler Core	Install a new core for the oil cooler.
	Failure of Cylinder Head Gasket	Install a new cylinder head gasket. Tighten the bolts holding the cylinder head, according to the Specifications.
	Crack or Defect in Cylinder Head	Install a new cylinder head.
	Crack or Defect in Cylinder Block	Install a new cylinder block.
	Failure of Liner Seals	Replace seals.

Problem	Cause	Correction
20. TOO MUCH BLACK OR GRAY SMOKE	Not Enough Air For Combustion	Check air cleaner for restrictions.
	Bad Fuel Injection Valve(s)	Install new fuel injection valve(s).
	Wrong Fuel Injection Timing	Make adjustments to timing.
	Defect in Fuel Ratio Control	Make adjustment to or install new control.
21. TOO MUCH WHITE OR BLUE SMOKE	Too Much Lubrication Oil in Engine	Remove extra oil. Find where extra oil comes from. Put correct amount of oil in engine. Do not put too much oil in engine.
	Misfiring or Running Rough	Make Reference to Item 3.
	Wrong Fuel Injection Timing	Make adjustment to timing.
	Worn Valve Guides	Reconditioning of cylinder head is needed.
	Worn Piston Rings	Install new piston rings.
	Failure of Turbocharger Oil Seal	Check inlet manifold for oil and repair turbocharger if necessary.
22. ENGINE HAS LOW OIL PRESSURE	Dirty Oil Filter or Oil Cooler	Check the operation of bypass valve for the filter. Install new oil filter elements if needed. Clean or install new oil cooler core. Remove dirty oil from engine. Put clean oil in engine.
	Diesel Fuel in Lubrication Oil	Find the place where diesel fuel gets into the lubrication oil. Make repairs as needed. Remove the lubrication oil that has diesel fuel in it. Install a new oil filter element. Put clean oil in the engine.
	Too Much Clearance Between Rocker Arm Shaft and Rocker Arms	Check lubrication in valve compartment. Install new parts as necessary.
	Oil Pump Suction Pipe Has A Defect	Replacement of pipe is needed.

Problem	Cause	Correction
22. ENGINE HAS LOW OIL PRESSURE (CONT.)	Pressure Regulating Valve Does Not Close	Clean valve and housing. Install new parts as necessary.
	Oil Pump Has A Defect	Repair or replacement of oil pump if needed.
	Too Much Clearance Between Crankshaft and Crankshaft Bearings	Check the oil filter for correct operation. Install new parts if necessary.
	Too Much Clearance Between Camshaft and Camshaft Bearings	Install new camshaft and camshaft bearings if necessary.
	Defect in Oil Pressure Gauge	Install new gauge.
23. ENGINE USES TOO MUCH LUBRICATION OIL	Too Much Lubricating Oil in Engine	Remove extra oil. Find where extra oil comes from. Put correct amount of oil in engine. Do not put too much oil in engine.
	Oil Leaks	Find all oil leaks. Make repairs as needed.
	Oil Temperature is Too High	Check operation of oil cooler. Install new parts if necessary. Clean the core of the oil cooler.
	Too Much Oil in the Valve Compartment	Look at both ends of the rocker arm shaft. Be sure that there is a plug in each end.
	Worn Valve Guides	Reconditioning of the cylinder head is needed.
	Worn Piston Rings	Inspect and install new parts as needed.
24. ENGINE COOLANT IS TOO HOT	Restriction To Flow of Coolant Through Radiator Core Tubes	Clean and flush radiator.
	Restriction To Air Flow Through Radiator	Remove all restrictions of flow.
	Low Fan Speed	Check for worn or loose fan belts.
	Not Enough Coolant in System	Add coolant to cooling system.

Problem	Cause	Correction
24. ENGINE COOLANT IS TOO HOT (CONT.)	Pressure Relief Valve Has A Defect	Check operation of pressure relief valve. Install a new pressure relief valve if necessary.
	Combustion Gases in Coolant	Find out where gases get into the cooling system. Make repairs as needed.
	Water Temperature Regulators (Thermostats) or Temperature Gauge Has A Defect	Check water temperature regulators for correct operation. Check temperature gauge operation. Install new parts as necessary.
	Water Pump Has A Defect	Make repairs to the water pump as necessary.
	Too Much Load On The System	Make a reduction to the load.
	Wrong Fuel Injection Timing	Make adjustment to timing.
	Torque Converter or Transmission Not Operating Correctly Causing An Increase In The Coolant Temperature	Make corrections for torque converter or transmission running too hot.
25. STARTING MOTOR DOES NOT TURN	Battery Has Low Output	Check condition of battery. Charge battery or make replacement as necessary.
	Wiring or Switch Has Defect	Make repairs or replacement as necessary.
	Starting Motor Solenoid Has A Defect	Install a new solenoid.
	Starting Motor Has A Defect	Make repair or replacement of starting motor.

Problem	Cause	Correction
26. ALTERNATOR GIVES NO CHARGE	Loose Drive Belt For Alternator	Make an adjustment to put the correct tension on the drive belt.
	Charging or Ground Return Circuit or Battery Connections Have A Defect	Inspect all cables and connections. Clean and tighten all connections. Make replacement of parts with defect.
	Brushes Have A Defect	Install new brushes.
	Rotor (Field Coil) Has A Defect	Install a new rotor.
27. ALTERNATOR CHARGE RATE IS LOW OR NOT REGULAR	Loose Drive Belt For Alternator	Make an adjustment to put the correct tension on the drive belt.
	Charging or Ground Return Circuit or Battery Connections Have A Defect	Inspect all cables and connections. Clean and tighten all connections. Make replacement of parts with defects.
	Alternator Regulator Has A Defect	Make an adjustment or replacement of alternator regulator.
	Alternator Brushes Have A Defect	Install new brushes.
	Rectifier Diodes Have A Defect	Make replacement of rectifier diode that has a defect.
	Rotor (Field Coil) Has A Defect	Install a new rotor.
28. ALTERNATOR CHARGE TOO HIGH	Alternator or Alternator Regulator Has Loose Connections	Tighten all connections to alternator or alternator regulator.
	Alternator Regulator Has A Defect	Make an adjustment or replacement of alternator regulator.

Problem	Cause	Correction
29. ALTERNATOR HAS NOISE	Drive Belt For Alternator is Worn or Has A Defect	Install a new drive belt for the alternator.
	Loose Alternator Drive Pulley	Check groove in pulley for key that holds pulley in place. If groove is worn, install a new pulley. Tighten pulley nut according to Specifications.
	Drive Belt and Drive Pulley For Alternator Are Not in Alignment	Make an adjustment to put drive belt and drive pulley in correct alignment.
	Worn Alternator Bearings	Install new bearings in the alternator.
30. EXHAUST TEMPERATURE IS TOO HIGH	Air Inlet System Has A Leak	Check pressure in the air intake manifold. Look for restrictions at the air cleaner. Correct any leaks.
	Exhaust System Has A Leak	Find cause of exhaust leak. Make repairs as necessary.
	Air Inlet or Exhaust System Has A Restriction	Remove restriction.
	Wrong Fuel Injection Timing	Make an adjustment to the timing.

FUEL SYSTEM

Either too much fuel or not enough fuel for combustion can be the cause of a problem in the fuel system.

Many times work is done on the fuel system when the problem is really with some other part of the engine. Finding the source of the problem is difficult, especially when smoke is coming from the exhaust. Smoke coming from the exhaust can be caused by a bad fuel injection valve, but it can also be caused by the following:

a. Not enough air for good combustion.
b. An overload at high altitude.
c. Burning of too much oil.
d. Not enough compression.

FUEL SYSTEM INSPECTION

1. Look at the reading on the gauge for fuel pressure. Not enough fuel pressure is an indication of a problem with the components that send fuel to the engine.
2. Check the fuel level in the fuel tank. Look at the cap for the fuel tank to make sure the vent is not filled with dirt.
3. See that the vent valve is closed.
4. Check the fuel lines for fuel leakage. Be sure the fuel supply line does not have a restriction or a bad bend.
5. Install a new fuel filter. Clean the primary fuel filter if the machine is so equipped.
6. Remove any air that may be in the fuel system.
7. Inspect the fuel bypass valve to see that there is no restriction to good operation.

TESTING FUEL INJECTION EQUIPMENT

An easy check can be made to find the cylinder that is misfiring, or running rough, and causing black smoke to come out of the exhaust pipe.

Run the engine at the speed that gives misfiring. Loosen the fuel line nut at a fuel injection pump or valve. This will stop the flow of fuel to that cylinder. Do this for each cylinder until a loosened fuel line is found that makes no difference in engine running. Be sure to tighten each fuel line nut after the test before the next fuel line nut is loosened. Check each cylinder by this method. When a cylinder is found where the loosened fuel line nut does not make a difference in engine running, test the injection pump and injection valve for that cylinder.

Checking the Fuel Injection Valves

Check the fuel injection valves for:

1. Too much carbon on the tip of the nozzle or in the nozzle orifice.
2. Wear of the orifice.
3. Nozzle screen being dirty.

Use the Caterpillar Diesel Fuel Injection Test Bench to test the nozzle.

Checking the Plunger and Lifter Washer

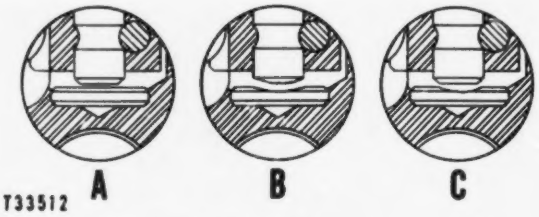
Check timing dimension for the fuel injection pumps. Make an adjustment if necessary, with the pump housing off the engine. When an adjustment to the timing dimensions is done correctly, fuel injection in the cylinder will be at the correct time. If the timing dimension is too small, fuel injection will be early. If the timing dimension is too large, fuel injection will be late.

An injection pump can have a good fuel flow coming from it but not be a good pump because of slow timing that is caused by wear on the bottom end of the plunger. When making a test on a pump that has been used for a long time, use a micrometer and measure the length of the plunger. If the length of the plunger is shorter than the minimum length (worn) dimension given in the chart, install a new pump.

FUEL PUMP PLUNGER	
Length (new)	2.7212 ± .0015 in. (69.118 ± 0.038 mm)
Minimum length (worn)	2.7147 in. (68.953 mm)

Look for wear at the top part of the plunger. Check the operation of the plunger according to the instructions for the Fuel Injection Test Bench.

When there is too much wear on the pump plunger, the lifter washer may also be worn and there will not be good contact between the two parts. To stop fast wear on the end of a new plunger, install new lifter washer in the place of those with wear.



WEAR BETWEEN LIFTER WASHER AND PLUNGER

Illustration A shows the contact surfaces of a new pump plunger and a new lifter washer. In illustration B the pump plunger and lifter are both worn very much. Illustration C shows how the flat end of a new plunger does not make a good contact with a worn lifter washer. This causes much wear to both parts.

FUEL INJECTION SERVICE

Injection Valve

Check the seat of the nozzle and the seat in the precombustion chamber before installing the fuel injection valve. It is important to keep the correct torque on the nut that holds the fuel nozzle in the precombustion chamber. Tighten the nut to 105 ± 5 lb.ft. (14.5 ± 0.7 mkg).

CAUTION: There will be damage to the nozzle if the nut is too tight. If the nut is not tight enough the nozzle can leak or split.

Removal of the Fuel Injection Pump

Tools Needed: 8S4613 Wrench.
8S2244 Extractor.

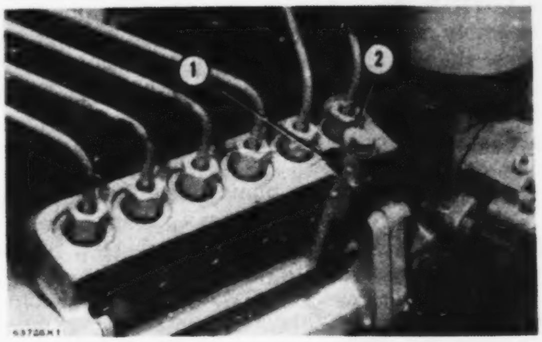
When injection pump barrels, plungers and lifters are removed from the injection pump housing, keep the parts of the pump together and mark them so they can be installed back in their original location. The rack must be in the center position before removing the pumps.

Be careful when removing injection pumps. Do not damage the surface on the plunger. The plunger and barrel for each pump are made as a set. Do not put the plunger of one pump in the barrel of another pump. If one part is worn install a complete new pump assembly. Be very careful when putting the plunger in the bore of a barrel.

Installation of the Fuel Injection Pump

When installing the fuel injection pump assemblies in the pump housing the pump camshaft must be turned so the lifter is on the lowest point of the cam. The rack must also be in the center position.

1. Remove the air-fuel ratio control and push in the speed limiter.



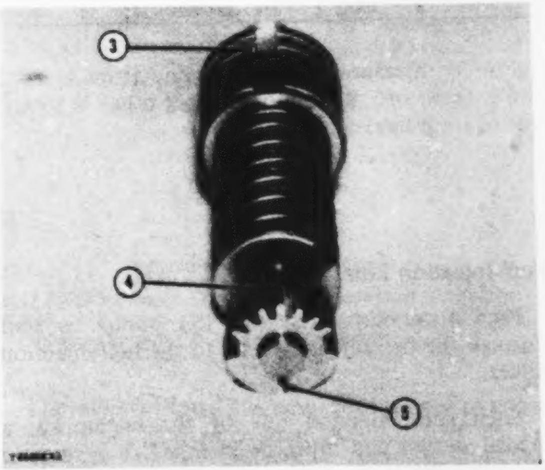
LOCATION OF THE RACK CENTERING PIN

1. Rack centering pin. 2. Rack centering pin cover.

2. Remove the rack centering pin cover (2) and push in the rack centering pin (1). Move the governor control lever to the FUEL OPEN position. The rack centering pin will fall into a slot in the fuel rack and stop the movement of the rack so the rack is in the center position. Keep the governor linkage in this position.

NOTE: Put part of the centering pin cover (2) over the centering pin (1) and tighten the bolt with the fingers to hold the pin (2) in position.

3. Make an alignment of the groove (3) on the bonnet and barrel with the center tooth (4) of the gear segment.



ALIGNMENT OF GROOVE WITH GEAR TOOTH

3. Groove. 4. Center tooth. 5. Notch.

4. Put the injection pump into the housing. Notch (5) must be in alignment with the dowel in the lifter. The groove (3) must be in alignment with the dowels in the pump bore. Push the pump into the housing while installing the retainer bushing.

CAUTION: Do not put a large force on the pump assembly while installing it into the housing because the dowel in the lifter will be broken. If this dowel is broken, the pump assembly can be installed with the teeth of the gear segment out of alignment with the correct teeth of the rack.

5. When the injection pump assembly is installed correctly, the retainer bushing can be tightened with the fingers so the top of the bushing is even with the top of the housing.
6. After the injection pump is installed correctly, tighten the bushing to 150 ± 10 lb.ft. (20.7 ± 1.4 mkg) with the 8S4613 Wrench.

The total rack movement is approximately .800 in. (20.32 mm). There will be a reduction in this movement if the teeth of the gear segment on the plunger are not installed in correct relation with the gear teeth of the rack. The only way to check for correct installation of all the pumps is to measure the full movement of the rack when the complete governor assembly is removed.

EXAMPLE OF RACK TRAVEL

TEETH OFF	TOTAL RACK TRAVEL		TRAVEL FROM CENTER POSITION		TOTAL TRAVEL REDUCTION	
	in.	mm	in.	mm	in.	mm
0	.8	20.	.4	10.	0	0
1	.6	15.	.3	7.	.2	5.

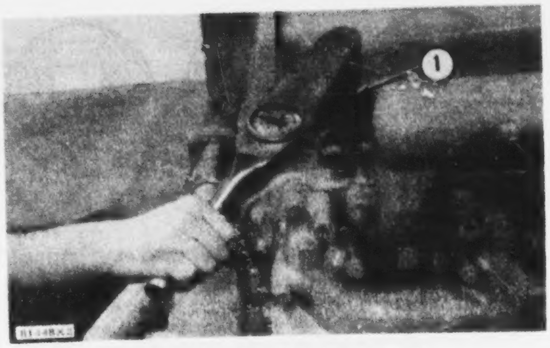
Similar measurements will come from being 2 and 3 teeth off. Reduction of rack travel is greater but will not have a constant ratio.

Fuel Injection Lines

Fuel from the fuel injection pumps is sent through the fuel injection lines to the fuel injection valves.

Each fuel injection line of the engine has a special design and must be installed in a specific location. When fuel injection lines are removed from an engine, put identification marks or tags on the lines as they are removed so they can be put in the correct location when they are installed.

The nuts that hold a fuel injection line to an injection valve and injection pump must be kept tight. Use a torque wrench and the 5P144 Fuel Line Socket (1) to tighten the fuel line nuts to 30 ± 5 lb.ft. (4.1 ± 0.7 mkg).



TIGHTENING THE NUT OF A FUEL INJECTION LINE

1. 5P144 Fuel Line Socket.

Fuel Bypass Valve

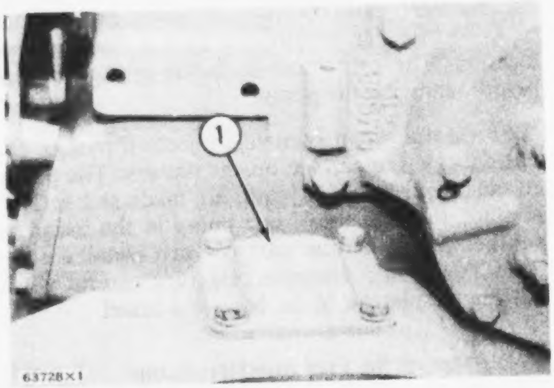
The fuel bypass valve controls fuel pressure to the fuel injection pump at full speed to a pressure of 32 ± 7 psi (2.25 ± 0,49 kg/cm^2).

Finding Top Center Compression Position for No. 1 Piston

Tools Needed: 2P8300 Engine Turning Tool Group.

No. 1 piston at top center (TC) on the compression stroke is the starting point for all timing procedures.

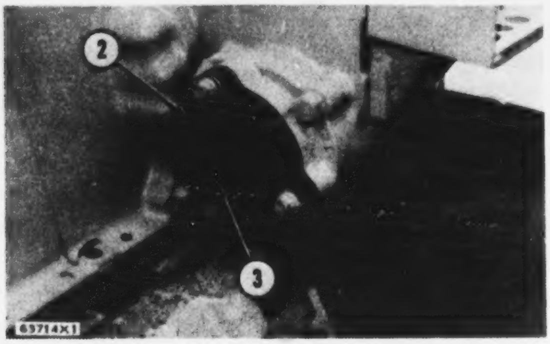
1. Remove the front valve cover. The two valves at the front of the engine are the intake and exhaust valves for No. 1 cylinder. Remove the cover (1) which is on the top of the flywheel housing.



COVER LOCATION

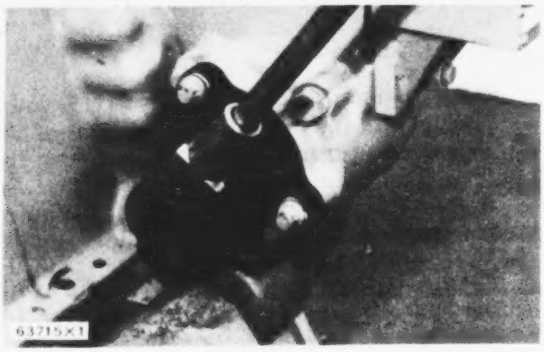
1. Cover.

2. Remove the starter. Install the 2P8295 Housing (2) into the flywheel housing. Install the 2P8298 Gear Assembly (3) into the housing (2).



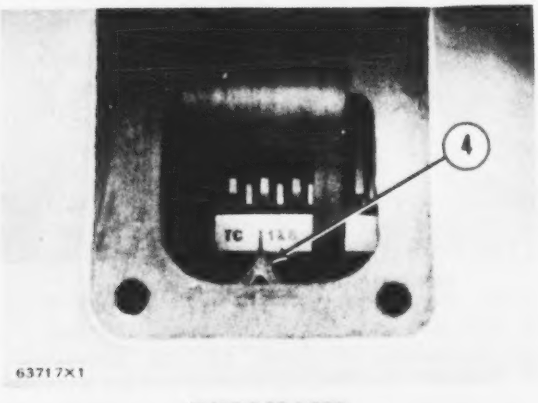
ENGINE TURNING TOOLS INSTALLED
2. 2P8295 Housing. 3. 2P8298 Gear Assembly.

3. Use a ratchet and 1 in. socket to turn the engine.



TURNING THE ENGINE

4. Rotate the crankshaft counterclockwise (looking from the flywheel end) more than 60°, until both the intake and exhaust valves of No. 1 cylinder are closed and the timing pointer (4) is in alignment with the mark TC 1 & 6 on the flywheel. The No. 1 piston is the position of top center (TC) on compression.



TIMING POINTER
4. Timing pointer.

FUEL SYSTEM ADJUSTMENTS

Checking the Timing of the Fuel Injection Pump: On Engine

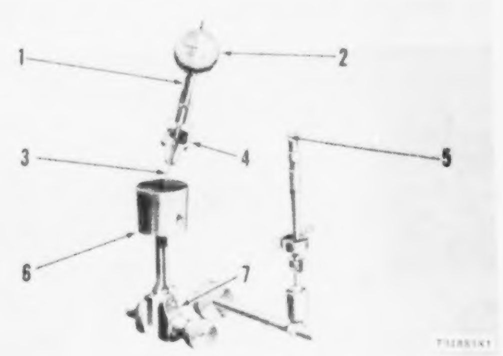
The timing dimension should be checked and changed if necessary, to correct any movement in the relation of the accessory drive shaft to the tapered sleeve or to correct for worn timing gears.

Checking with 1P540 Flow Checking Tool Group and 3S2954 Timing Indicator Group

Tools Needed: 1P540 Flow Checking Tool Group.
3S2954 Timing Indicator Group.
9M9268 Dial Indicator.

See Special Instruction (FM035709) for complete instructions for the fuel flow method of timing.

Travel of piston (6), from point of closing inlet port (5) to top center, can be found by using the 3S2954 Timing Indicator Group. Change the travel of the piston (6) into degrees of rotation of the crankshaft to check if the engine timing is correct.



MEASURING PISTON TRAVEL
1. 3S3263 Adapter. 2. 9M9268 Dial Indicator. 3. 3S3264 Rod. 4. Precombustion chamber. 5. Inlet port in fuel injection pump housing. 6. Piston. 7. Crankshaft.

The 1P540 Flow Checking Tool is used to cause pressure in the fuel system. Keep 10 to 15 psi (0.70 to 1.05 kg/cm²) fuel pressure with the 1P539 Tank Assembly. This can be done with the hand pump of the tank assembly or by connecting the air supply of the shop to the tank.

⚠ WARNING: Be sure to make an adjustment to the regulator so the air supply in the tank is a maximum of 15 psi (1.05 kg/cm²).

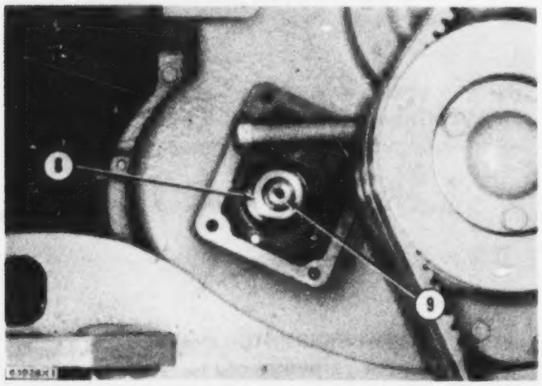
Check chart to find the relation of the timing angle to the indicator reading. At the correct timing angle and indicator reading, (the point at which inlet port (5) is closed) 6 to 12 drops per minute must flow from the injection pump.

TIMING ANGLE	INDICATOR READING	
14° 0′ •14° 17′ 14° 30′	.159 in. .166 in. .171 in.	4.04 mm 4.22 mm 4.34 mm
•Correct timing.		

NOTE: If timing angle is not correct, change timing as follows:

Tools Needed: **8S2264 Puller Group.**
8S7561 Step Plate.
8S8375 Sleeve.
5P294 Crowfoot Wrench.

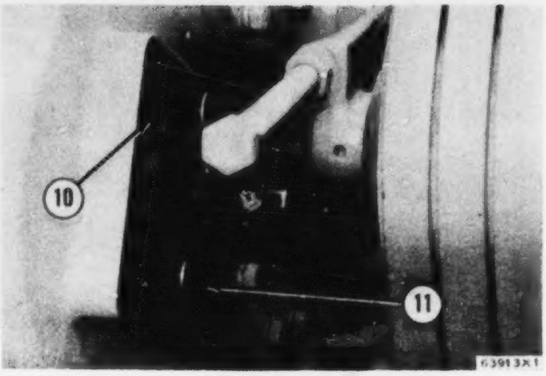
1. Release the pressure from the 1P540 Flow Checking Tool Group.
2. Remove the four bolts holding the cover to the timing gear housing and remove the cover.
3. Remove the nut (8) from the shaft (9). Remove the conical washer from the shaft (9).



NUT HOLDING GEAR TO ACCESSORY DRIVE SHAFT

8. Nut. 9. Shaft.

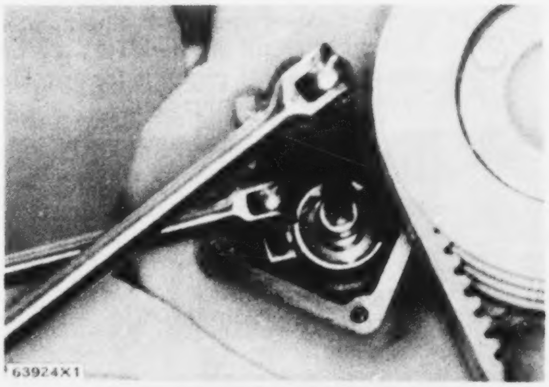
4. Loosen the gear from the accessory drive shaft (9) using an 8S8375 Sleeve, 8B7561 Step Plate, and the 8S2264 Puller Group (10) with two 5B6579 Bolts (11) (3/8 in. 24–NF, 5.5 in. long) and two 3/8 in. flat washers.
5. Turn the crankshaft 30° clockwise (looking from the flywheel end). Then turn the crankshaft counterclockwise until the No. 1 piston is .166 in. (4.22 mm) from top center (TC). Read measurement from gauge (2). This is the correct indicator reading for 14° 17' timing before top center.



LOOSENING GEAR

10. 8S2264 Puller Group. 11. Bolt.

6. Put a maximum pressure of 15 psi (1.05 kg/cm^2) on the fuel system with the 1P540 Flow Checking Tool Group.
7. Use a 3/4 in. socket to turn the shaft (9) counterclockwise (as viewed from the front of the engine) until there is a flow of fuel from the tube. Then turn shaft (9) clockwise (as viewed from the front of the engine) until the flow of fuel from the tube is 6 to 12 drops per minute.
8. Put the conical washer on the shaft (9) with the large diameter against the timing gear. Install the nut (8).
9. Use a 5P294 Crowfoot Wrench and 3/4 in. socket to tighten the nut (8) on the shaft (9) to approximately 75 lb.ft. (10.4 mkg).



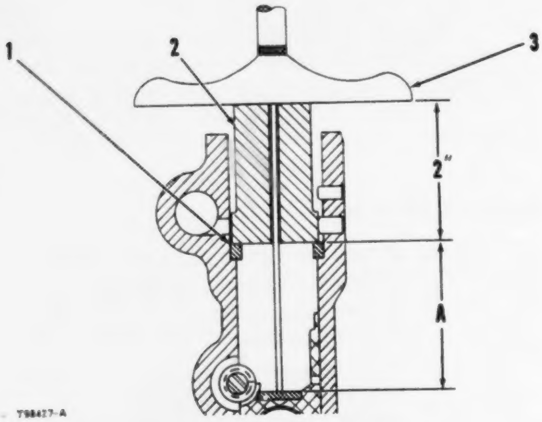
USING THE 5P294 CROWFOOT WRENCH

10. Remove the crowfoot wrench and use a torque wrench and 1 11/16 in. socket to tighten the nut to a last torque of 125 ± 10 lb.ft. (17.3 ± 1.4 mkg).

Checking with 8S7167 Gauge

Tools Needed: 8S7167 Gauge.
6F6922 Depth Micrometer, 4 or 5 in. (101.6 to 127.0 mm) rod.
8S4613 Wrench.
8S2244 Extractor.

1. Turn crankshaft so No. 1 piston is at top center (TC) on compression.
2. Remove the No. 1 fuel injection pump with the 8S4613 Wrench and 8S2244 Extractor. Put the gauge (2) into the bore of the fuel pump housing.
3. The correct timing dimension, as read from the depth micrometer (3), is 4.2956 ± .0020 in. (109.108 ± 0.051 mm).



CHECKING TIMING DIMENSION

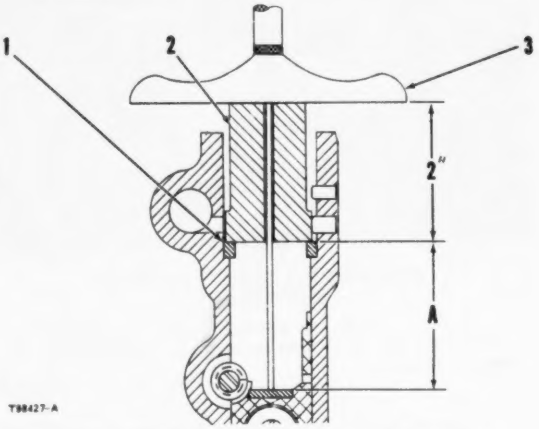
1. Spacer. 2. 8S7167 Gauge. 3. 6F6922 Depth Micrometer with 4 to 5 in. (101.6 to 127.0 mm) rod. Dimension "A" must be 2.2956 ± .0020 in. (58.308 ± 0.051 mm): [4.2956 ± .0020 in. (109.108 ± 0.051 mm) from the micrometer reading minus the 2 in. (50.8 mm) thickness of the 8S7167 Gauge].

4. If the timing dimension is not correct, check the accessory drive shaft timing. See ACCESSORY DRIVE SHAFT TIMING.
5. If the accessory drive shaft timing is correct and the timing dimension is not correct the timing setting must be corrected. See MAKING A CHANGE TO THE TIMING DIMENSION FOR THE FUEL INJECTION PUMP: OFF ENGINE.

Making a Change to the Timing Dimension for the Fuel Injection Pump: Off Engine

Tools Needed: 1P5600 Off Engine Lifter Setting Tool Group.
8S7167 Gauge.
8S4613 Wrench.
8S2244 Extractor.
6F6922 Depth Micrometer with 4 to 5 in. (101.6 to 127.0 mm) rod.

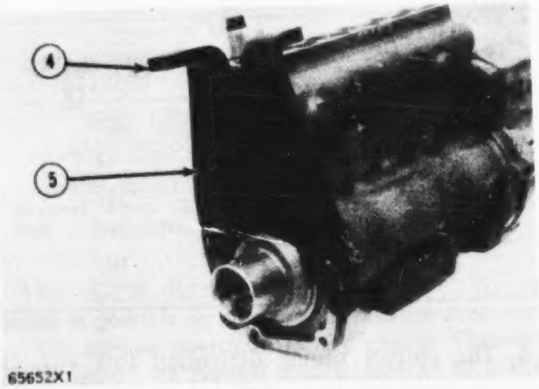
NOTE: The off engine lifter setting corrects for wear in the fuel injection pump housing only. The accessory drive shaft timing corrects for wear in the timing gears, accessory drive shaft, and fuel pump camshaft.



CHECKING TIMING DIMENSION (OFF ENGINE)

1. Spacer. 2. 8S7167 Gauge. 3. 6F6922 Depth Micrometer with 4 to 5 in. (101.6 to 127.0 mm) rod. Dimension "A" must be 2.3689 ± .0020 in. (60.170 ± 0.051 mm).

1. Install the 1P7420 Pointer (4) on the fuel injection pump housing.

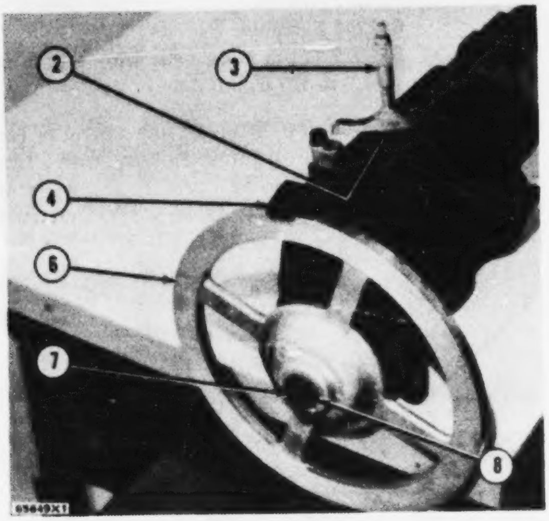


POINTER INSTALLED

4. 1P7420 Pointer. 5. S1617 Bolt.

2. Install the 2M5218 Shaft on the drive end of the camshaft.

3. Install the 1P7410 Timing Plate (6) on the 2M5218 Shaft with a S509 Bolt (7) and 2S6160 Washer (8).



CHECKING THE TIMING DIMENSION
(OFF ENGINE)

2. 8S7167 Gauge. 3. 6F6922 Depth Micrometer. 4. 1P7420 Pointer. 6. 1P7410 Timing Plate. 7. S509 Bolt. 8. 2S6160 Washer.

4. Look at the chart and select the correct degree setting on the timing plate for each lifter being checked or set. Put the timing plate (6) in position by rotating it clockwise until the correct degree mark is in alignment with the pointer.

LIFTER SETTING IN DEGREES (OFF ENGINE)

LIFTER NO. (Numbered consecutively front to rear)	TIMING PLATE DEGREES
1	257°
2	17°
3	137°
4	317°
5	197°
6	77°

5. The correct timing dimension (off engine), using the 8S7167 Gauge (2), as read from the depth micrometer (3) is 4.3689 ± .0020 in. (110.970 ± 0.051 mm).

6. To change the timing dimension, change the spacer (1). See the SPACER PART NUMBER AND THICKNESS CHART.

SPACER PART NUMBER AND THICKNESS CHART

SPACER NO.	SPACER THICKNESS	
5M2697	.170 in.	4.32 mm
2M4208	.174 in.	4.42 mm
2M4209	.178 in.	4.52 mm
2M4210	.182 in.	4.62 mm
2M4211	.186 in.	4.72 mm
2M4212	.190 in.	4.83 mm
5M2691	.194 in.	4.93 mm
5S7189	.198 in.	5.03 mm

7. If all timing dimensions are going to be checked or changed to the correct setting, do the same procedure in the firing order of the engine (1, 5, 3, 6, 2, 4). Check each timing dimension after the adjustment has been made.

NOTE: The accessory drive shaft must be in the correct position in relation to the engine crankshaft before installing the fuel injection pump housing. See ACCESSORY DRIVE SHAFT TIMING.

Accessory Drive Shaft Timing

Tools Needed: 5P4240 Timing Fixture Plate.
3S2954 Timing Indicator Group.
8S2264 Puller Group.
8S7561 Step Plate.
8S8375 Sleeve.
5P294 Crowfoot Wrench.
2P8300 Engine Turning Tool Group.

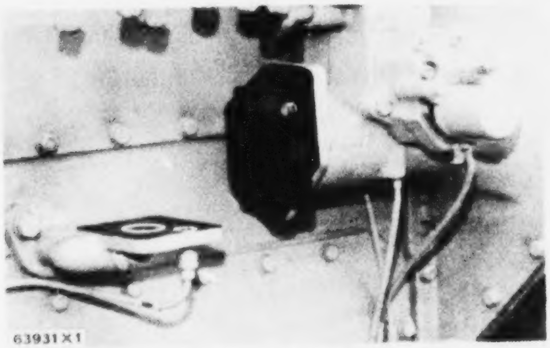
1. Remove the fuel injection pump housing and turn the engine crankshaft so No. 1 piston is on the compression stroke at top center (TC).

2. Install the 5P4240 Timing Fixture Plate on the rear face of the accessory drive housing. Make sure the dowels are in alignment with the correct holes.

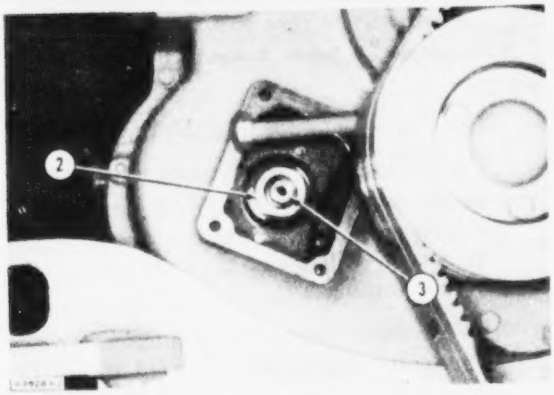
NOTE: If the timing fixture plate (1) cannot be installed do the following:

3. Remove the four bolts holding the cover to the timing gear housing and remove the cover.

4. Remove the nut (2) from the shaft (3). Remove the conical washer from the shaft (3).



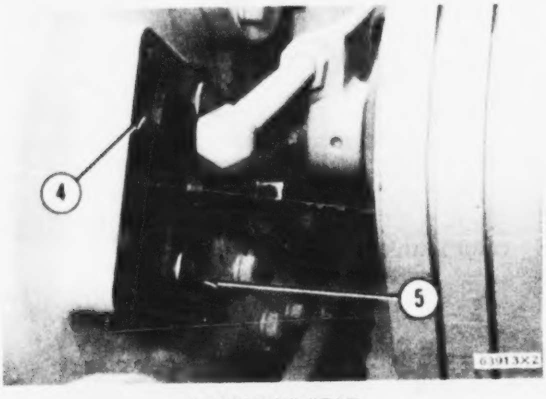
5P4240 TIMING FIXTURE PLATE INSTALLED



NUT HOLDING GEAR TO ACCESSORY DRIVE SHAFT

2. Nut. 3. Shaft.

5. Loosen gear from the accessory drive shaft (3) using an 8S8375 Sleeve, 8B7561 Step Plate and the 8S2264 Puller Group (4) with two 5B6579 Bolts (5) (3/8 in. 24–NF, 5.5 in. long) and two 3/8 in. flat washers.



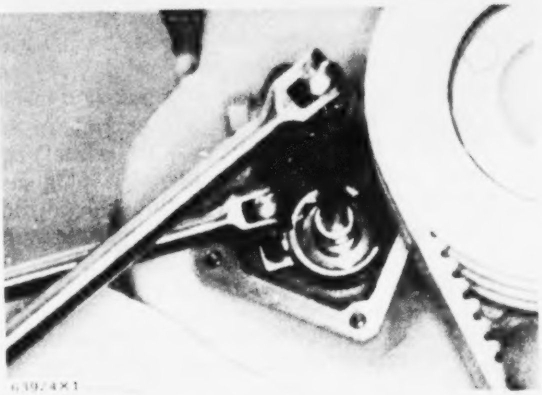
LOOSENING GEAR

4. 8S2264 Puller Group. 5. Bolt.

6. Turn the accessory drive shaft in the direction needed to install the 5P4240 Timing Fixture Plate.

7. Put the conical washer on the shaft (3) with the large diameter against the timing gear. Install the nut (2).

8. Use a 5P294 Crowfoot Wrench and a 3/4 in. socket to tighten the nut (2) on the shaft (3) to approximately 75 lb.ft. (10.4 mkg).

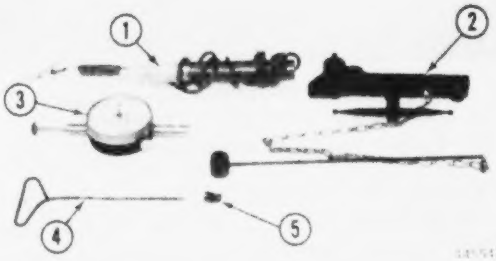


USING THE 5P294 CROWFOOT WRENCH

9. Remove the crowfoot wrench and use a torque wrench and 1 11/16 in. socket to tighten the nut to a last torque of 125 ± 10 lb.ft. (17.3 ± 1.4 mkg).

Fuel Rack Setting

Tools Needed: **9S240 Rack Positioning Tool Group.**
4B9820 Wrench.



PARTS OF 9S240 RACK POSITIONING TOOL GROUP

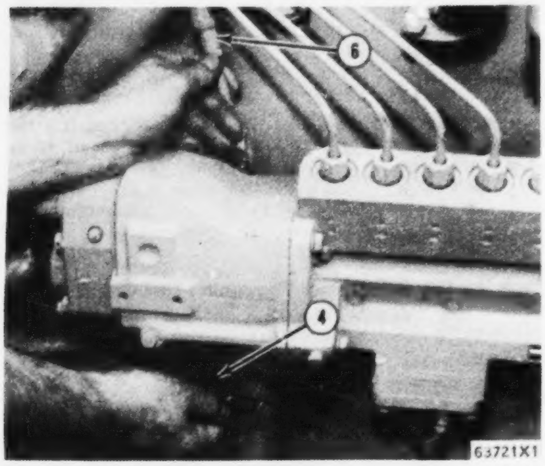
1. 8S4627 Circuit Tester. 2. 9S238 Rack Positioning Bracket Group. 3. 9S215 Dial Indicator. 4. 9S8521 Rod. 5. 9S8518 Plug.

The 9S238 Rack Positioning Bracket Group makes it possible to measure the rack position during the normal operation of the engine. This will give most of the needed information to find the horsepower being put out by the engine and to find the cause for less than normal power.

CAUTION: Rack setting is carefully set at the factory and must not be changed unless it is known to be wrong. A wrong setting of the fuel rack will cause a problem with the turbocharger.

1. See the book RACK SETTING INFORMATION to find the correct rack setting dimension.
2. Disconnect the governor control linkage (6). Remove access plug for the speed limiter from the bottom of the governor housing and install the 9S8518 Plug. Through the opening in the plug, use the rod (4) to push in (retract) the speed limiter plunger. Tighten the plug just enough to cause a clamp action on the rod. This will permit the governor control lever to move freely through its complete length of travel.

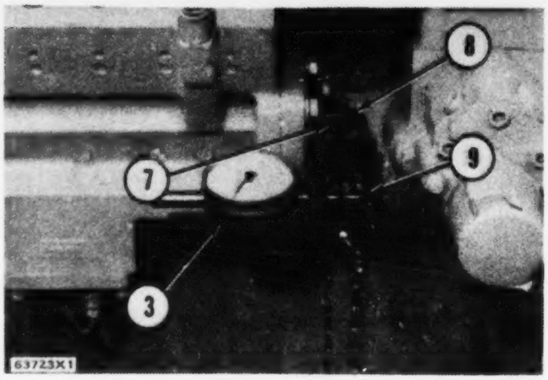
NOTE: The speed limiter puts a restriction on the travel of the rack until the plunger is pushed in.



DISCONNECTING GOVERNOR LINKAGE AND PUSHING IN SPEED LIMITER PLUNGER

4. 9S8521 Rod. 6. Governor control linkage.

3. Remove the fuel ratio control from the rear of the governor. Then remove the fuel rack cover and gasket from the front flange of the accessory drive housing.
4. Install the rack positioning bracket (2) over the opening for the fuel rack cover and gasket from the front flange of the accessory drive housing. Install the dial indicator (3) into the bracket (2) as shown.
5. Put the spacer (7) over the rod (8) in the bracket (2). Make an adjustment to the dial on the indicator to read zero when the hole attachment (9) is against the rod (10) and the rod is against the spacer (7).



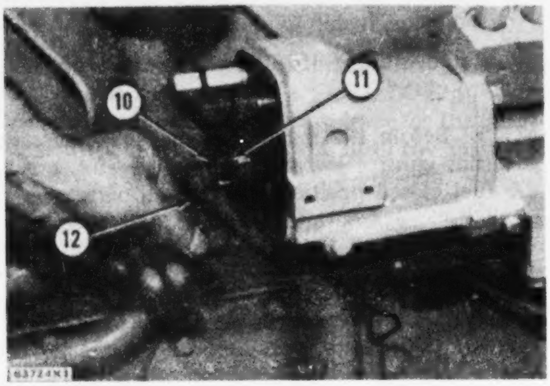
ADJUSTMENT OF ZERO TO DIAL INDICATOR

3. Dial indicator. 7. Spacer. 8. Rod. 9. Hole attachment.

6. Be sure the rack moves freely through its complete length of travel.
7. Connect one end of 8S4627 Circuit Tester to the brass screw on the outside of the governor. Connect the other end to some part of the governor housing.
8. With the speed limiter plunger pushed in move the governor control lever toward the FUEL OPEN position until the tester light becomes bright.
9. Slowly move the governor control lever toward the FUEL CLOSED position until the light goes off.
10. Then slowly move the governor control lever toward the FUEL OPEN position until the light just shows (a dim light). The adjustment screw in the rack collar is now just coming in contact with the stop bar. The rack setting dimension is read from the dial indicator (3).
11. To make an adjustment to the rack setting, loosen the locknut (11) and using wrench (12) make an adjustment to the screw (10) to get a correct rack setting dimension. The travel of the rack can also be read from the dial indicator in this position.

NOTE: Turn screw (10) clockwise to make a decrease in rack travel. Never make an adjustment to the rack travel by adding or removing shims.

12. When the correct adjustment has been made to the rack, tighten the locknut (11) to 11 ± 1 lb.ft. (1.5 ± 0.14 mkg).



MAKING AN ADJUSTMENT TO THE RACK SETTING

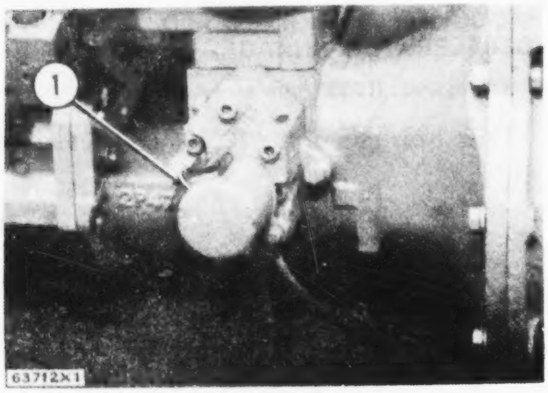
10. Screw. 11. Nut. 12. 4B9820 Wrench.

GOVERNOR ADJUSTMENTS

Tools Needed: 9S5609 Tachometer Drive Group.
4S6553 Engine Test Group.

CAUTION: A shop man with training in governor adjustments is the only one to make an adjustment to the low idle and high idle rpm. The correct low idle and high idle rpm and the measurement for the fuel rack are in the book RACK SETTING INFORMATION.

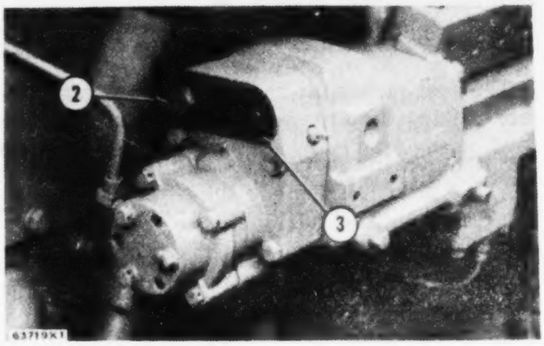
1. Remove the service meter (1) and install the 9S5609 Tachometer Drive Adapter Group.



REMOVE SERVICE METER

1. Service meter.

2. Remove the cover at the rear of the governor. Adjustments can be made by turning the low idle (2) and high idle (3) adjustment screws. Turning either adjustment screw clockwise will cause a decrease the respective low and high idle rpm. The retainer holes in the cover are in a shape to keep the screws from turning after the adjustment is made.



GOVERNOR ADJUSTMENT

2. Low idle adjustment screw. 3. High idle adjustment screw.

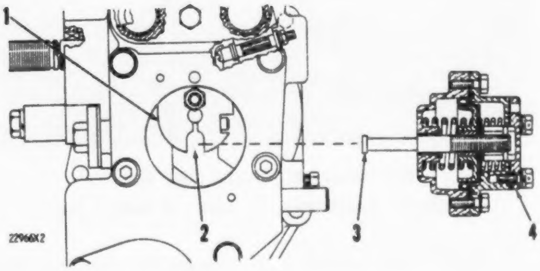
3. After making the adjustment to the idle rpm, move the control lever to change the engine rpm. Move it back to the idle position and check the idle rpm again. Make the adjustment using this method until the idle rpm shown in the book RACK SETTING INFORMATION is constant.

Fuel Ratio Control Installation

Before installing the fuel ratio control, make the correct adjustment to the fuel rack.

1. Install the bolt (3) in the notch (2) of the stop collar (1).

NOTE: If needed, move the collar (1) by turning the governor control lever from the FUEL OPEN to the FUEL CLOSED position. If more clearance is needed to install the bolt (3) in the notch (2), remove the retainer bolts in the cover (4) of the fuel ratio control and turn the cover (4) clockwise. This will turn the bolt (3).



FUEL RATIO CONTROL INSTALLATION

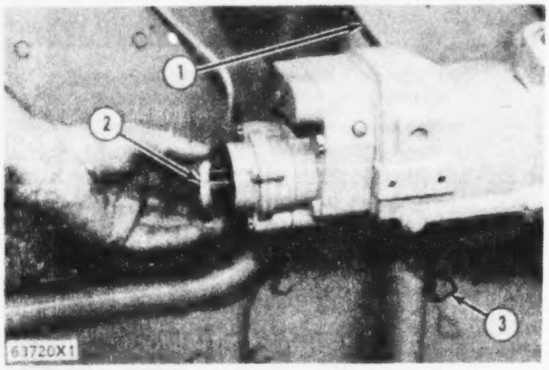
1. Stop collar. 2. Notch in stop collar. 3. Bolt. 4. Cover.

Fuel Ratio Control Setting

Tools Needed: 9S240 Rack Positioning Tool Group.

The fuel rack must have the correct setting before making the setting for the fuel ratio control.

1. Remove the rack cover plug from the accessory drive housing and the cover (2) from the rear of the fuel ratio control.
2. Engage the slot in the cover (2) with the dowel which goes through the bolt inside the fuel ratio control. Using the cover (2), turn the bolt in as far as possible. This prevents the head of the bolt from putting a restriction on the travel of the fuel rack.
3. Install the 9S238 Rack Positioning Bracket Group over the opening for the fuel rack cover on the front of the flange of the accessory drive housing. Install the dial indicator into bracket.
4. Remove the plug for the speed limiter from the bottom of the governor housing and install the 9S8518 Plug. Through the opening in the plug use the rod (3) to push in (retract) the speed limiter plunger. Tighten the plug just enough to cause a clamp action on the rod (3).
5. Move the rack to the center position and make an adjustment to zero on the dial indicator.
6. Move the governor control lever (1) to the FUEL OPEN position. Hold the lever in this position and make an adjustment by turning the bolt out until the correct reading is on the dial indicator. The correct reading is in the book RACK SETTING INFORMATION.



SETTING FUEL RATIO CONTROL

1. Governor control lever. 2. Cover. 3. 9S8521 Rod.

7. Turn the cover (2) clockwise the amount needed to make an alignment so the bolts can be installed through the holes in cover (2).
8. Remove the 9S238 Bracket and 9S215 Dial Indicator. Install the rack cover plug.
9. Remove the 9S8518 Plug and install the standard plug.

NOTE: Before starting the engine, make sure the governor control lever will move the governor to the fuel closed position and that all parts operate freely.

With the above adjustment made, other adjustments can be made while the engine is running to make an improvement in engine performance (if needed). To make a reduction in the exhaust smoke during speed increase, turn the cover (2) out (for less fuel) 1/2 turn at a time until correct. When exhaust smoke is acceptable but speed increase is slow, turn the cover (2) in (for more fuel) 1/2 turn at a time until the operation is correct.

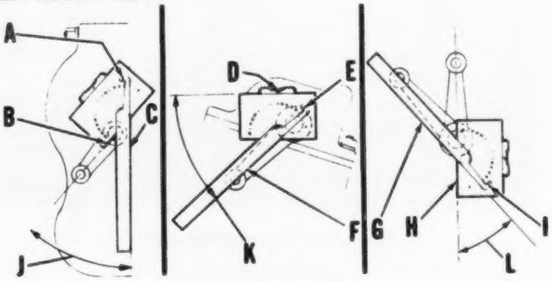
NOTE: Some exhaust smoke will be present at maximum speed increase.

If speed increase is slow and full engine power is lost, inspect the air line to the fuel ratio control and the gasket for air leaks. If no air leaks are present, inspect the diaphragm. A diaphragm with a break will not permit the fuel rack to move completely. This will make speed increase slow and full engine power will not be available.

ADJUSTMENTS TO GOVERNOR CONTROL LINKAGE AND LINKAGE FOR REDUCTION OF ENGINE SPEED (DECELERATOR LINKAGE)

Tools Required: 1P2385 Protractor Assembly.

Three basic uses of the 1P2385 Protractor tools are shown here.



1P2385 PROTRACTOR TOOL USE

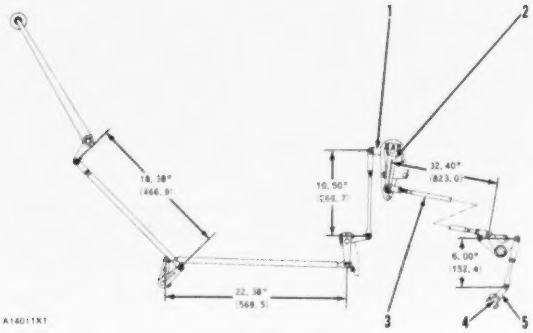
A. Indicator used for angle setting. B. Protractor plate edge in alignment with lever. C. Vertical housing face and extension arm are in alignment. D. Bubble in level. E. Indicator used for angle setting. F. Extension arm in alignment with lever. G. Extension arm in alignment with lever. H. Plate edge in alignment with second lever. I. Indicator used for angle setting. J. Angle between lever and vertical face of housing. K. Angle between level and lever. L. Angle between levers.

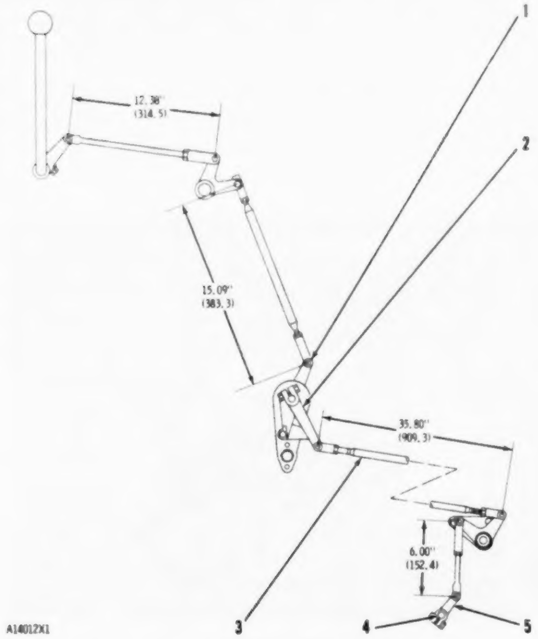
32231-1X1

Solid Linkage

All adjustments should be made when the governor control shaft is in the FUEL OFF position. Disconnect all linkage and turn lever for the governor control shaft (5) clockwise until the shaft will not move. This is the FUEL OFF position.

Measure the rods of the linkage. Make an adjustment to the rods (if needed) to the measurement given in the illustration most like the linkage being checked.





MEASURMENT OF GOVERNOR CONTROL LINKAGE (SOLID LINKAGE)
Dimensions in inches (mm)

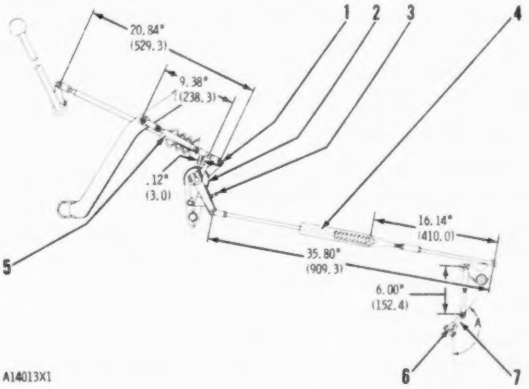
1. Lever connected to hand control lever (left side of engine as viewed from the flywheel end). 2. Lever (right side of engine). 3. Rod assembly. 4. Governor control shaft. 5. Lever for governor control shaft.

Linkage for Reduction of Engine Speed (Decelerator Linkage)

On engines with linkage for reduction of engine speed (decelerator linkage), check the measurements of the rods. Disconnect all linkage and make an adjustment to the rods (if needed) to the measurement given in the illustration.

Connect all the linkage and move the lever (7) to the HIGH IDLE position (A). Make an adjustment to the clamp (2) so the stop is at the dimension .12 in. (3.0 mm) when lever (1) is in the HIGH IDLE position. Tighten the bolt on the clamp (2).

Check the book RACK SETTING INFORMATION to find the LOW IDLE. Run the engine at a speed faster than LOW IDLE. Make an adjustment to bolt (3) so the engine runs at LOW IDLE when the pedal for reduction of engine speed (decelerator pedal) is pushed down and the bolt is against the stop.



MEASUREMENT OF GOVERNOR CONTROL LINKAGE (DECELERATOR LINKAGE)
Dimensions in inches (mm)

1. Lever connected to hand control lever (left side of engine as viewed from the flywheel end). 2. Clamp to stop lever (1) from being pulled back too far. 3. Bolt to make an adjustment to the maximum travel of decelerator linkage. 4. Rod for decelerator linkage. 5. Rod to foot pedal for decelerator linkage. 6. Governor control shaft. 7. Lever for governor control shaft. A. Angle from vertical where lever for governor control shaft is in HIGH IDLE position (122°).

AIR INLET AND EXHAUST SYSTEM

RESTRICTION OF AIR INLET AND EXHAUST

There will be a reduction of horsepower and efficiency of the engine if there is a restriction of the air inlet or exhaust system.

Air flow through the air cleaner must not have a restriction of more than 30 in. (762 mm) of water difference in pressure.

Back pressure from the exhaust (pressure difference measurement between exhaust outlet elbow and atmosphere) must not be more than 25 in. (635 mm) for naturally aspirated and 20 in. (508 mm) for turbocharged engines.

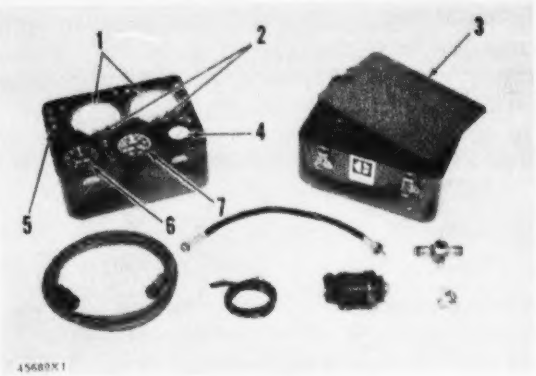
MEASUREMENT OF PRESSURE IN INLET MANIFOLD

By checking the pressure in the inlet manifold the efficiency of an engine can be checked by making a comparison with the information given in the book, RACK SETTING INFORMATION. This test is used when there is a decrease of horsepower from the engine, yet there is no real sign of a problem with the engine.

The correct pressure for the inlet manifold is given in the book, RACK SETTING INFORMATION. Development of this information is done with these conditions: 29.4 in. (746.76 mm) of mercury barometric pressure, 60°F (15.5°C) outside air temperature and 35 API rated fuel. Any change from these conditions can change the pressure in the inlet manifold. Outside air that has higher temperature and lower barometric pressure than given above will cause a lower horsepower and inlet manifold pressure measurement than given in the book, RACK SETTING INFORMATION. Outside air that has a lower temperature and higher barometric pressure will cause a higher horsepower and inlet manifold pressure measurement.

A difference in fuel rating will also change horsepower and the pressure in the inlet manifold. If the fuel is rated above 35 API, pressure in the inlet manfiold can be less than given in the book, RACK SETTING INFORMATION. If the fuel is rated below 35 API, the pressure in the inlet manifold can be more than given in the book, RACK SETTING INFORMATION. BE SURE THAT THE AIR INLET AND EXHAUST DO NOT HAVE A RESTRICTION WHEN MAKING A CHECK OF PRESSURE IN THE INLET MANIFOLD.

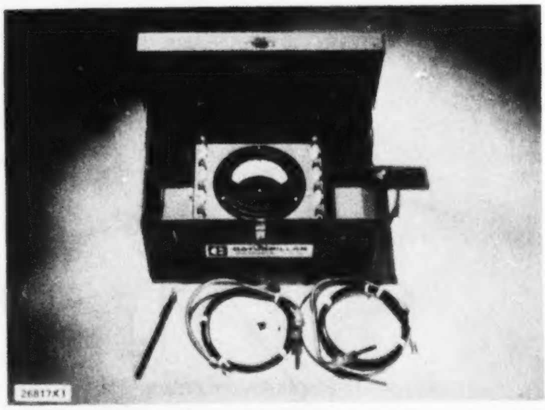
Use the 4S6553 Instrument Group to check engine rpm and the pressure in the inlet manifold. This instrument group has a tachometer for reading engine rpm. It also has a gauge for reading pressure in the inlet manifold. Special Instruction (FE036044) is with the tool group and gives instructions for the test procedure.



4S6553 INSTRUMENT GROUP

1. 4S6992 Differential Pressure gauges. 2. Zero adjustment screw. 3. Lid. 4. 8M2743 Gauge. 5. Pressure tap fitting. 6. 4S6991 Tachometer. 7. 4S6997 Manifold Pressure Gauge.

Use the 1P3060 Pyrometer Group to check exhaust temperature. Special Instruction (GMG00697) is with the tool group and gives instructions for the test procedure.



1P3060 PYROMETER GROUP

CRANKCASE (CRANKSHAFT COMPARTMENT) PRESSURE

Broken or damaged pistons or piston rings can be the cause of too much pressure in the crankcase.

This condition will cause the engine to run rough. There will also be more than the normal amount of fumes coming from the crankcase breather. This crankcase pressure can also cause the element for the crankcase breather to have a restriction in a very short time. It can also be the cause of oil leakage at gaskets and seals.

COMPRESSION CHECK

Tools Needed: 2P8300 Engine Turning Tool Group.

An engine that runs rough can have a leak at the valves, or valves that need adjustment. Run the engine at the speed that gives rough running. To find a cylinder that has low compression or does not have good fuel ignition, loosen a fuel line nut at a fuel injection pump or valve. This will stop the flow of fuel to that cylinder. Do this for each cylinder until a loosened fuel line is found that makes no difference in engine running. Be sure to tighten each fuel line nut after each cylinder test before the next fuel line nut is loosened. This test can also be an indication that the fuel injection is wrong, so more checking of the cylinder will be needed.

Condition of the valves, valve seats, pistons, piston rings and cylinder liners can be tested by putting air pressure in the cylinder. Special Instruction (GMG00694) gives instructions for the test procedure. It also gives the list of parts needed from Parts Department to make the test. 2P8300 Engine Turning Tool Group is needed for turning the engine.

This test is a fast method of finding the cause of compression loss in a cylinder. Removal of the head and inspection of the valves and valve seats is still necessary to find those small defects that do not normally cause a problem. Repair of these problems is normally done when reconditioning the engine.

VALVES

Use the 5S1330 Valve Spring Compressor Assembly with the 5S1329 Jaw to put the valve spring under compression. Use the 5S1322 Valve Keeper Installer with the compressor assembly to make the installation of the valve keepers easier and faster.

The valves can also be removed with 7F4292 Valve Spring Compressor Group. The 7F4290 Adapter is installed on a rocker arm stud. When installing the valve springs with 7F4292 Group, use the FT195 Fabricated Tool to hold the valves in place.

VALVE SEAT INSERTS

Valve seat inserts are available with a larger outside diameter than the original size. The available inserts are in the chart.

VALVE SEAT INSERT PART NUMBER			
	Original Size	.005 in. (0.13 mm) Larger Than The Original Size	.010 in. (0.25 mm) Larger Than The Original Size
Intake	9M8745	4S8912	4S8913
Exhaust	8M9810	4S8896	4S8897

VALVE CLEARANCE SETTING

Refer to LUBRICATION AND MAINTENANCE PROCEDURES for details of valve clearance adjustment.

VALVE CLEARANCE SETTING: ENGINE STOPPED	
Exhaust	.020 in. (0.51 mm)
Intake	.016 in. (0.41 mm)

VALVE GUIDES

The intake and exhaust valves operate in replacement type valve guides. After the valves have been removed, clean the valve stems and valve guides.

The 4H446 Driver and 5P1727 Bushing is used for installation of new valve guides.

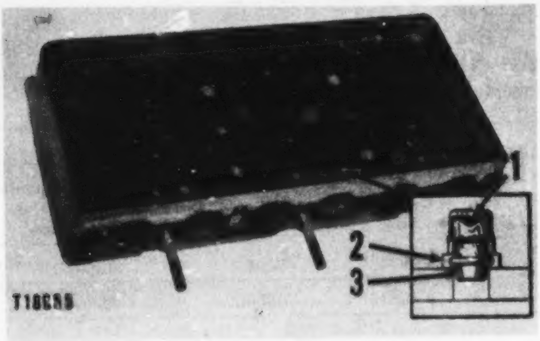
When installing the valve guides make sure that the small diameter of the guide is located at the top in the driver bushing.

The guides are to have a bore size of .5010 ± .0010 in. (12.725 ± 0.025 mm) after installation.

WATER DIRECTORS

There are twelve water directors (1) installed in each cylinder head. They give the coolant the desired direction of flow. On the exhaust side, the coolant flow goes toward the precombustion chambers and the exhaust valve ports; and on the intake side, the coolant flow goes to the other side of the valve ports.

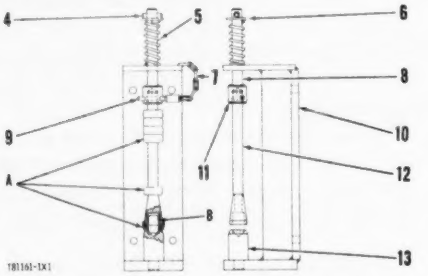
Water directors are installed with a press in the heads after the alignment of the notch on the director with the V-mark on the head.



WATER DIRECTORS

1. Water directors. 2. Seal. 3. Ferrule.

Replacement type seals (2) and ferrule (3) go between the head and top of the block. Put soap on the inner surface of the seal and put the seal over the flange on the ferrule before installing. Use the FT117 Seal and Ferrule Assembly Tool to install the seal on the ferrule.

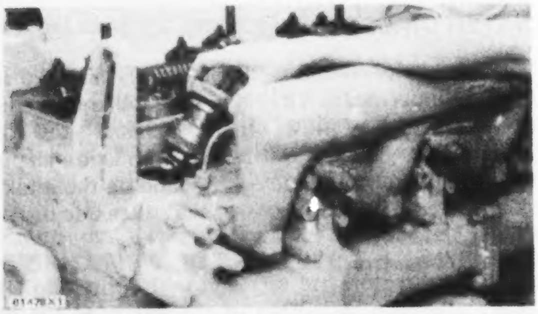


FT117 SEAL AND FERRULE ASSEMBLY TOOL

4. 5H3182 Pin.
5. 2A3672 Spring.
6. Flat Washer.
7. Chain.
8. Upper Rod.
9. Connecting Pin.
10. Bracket.
11. Connecting Joint.
12. Lower Rod.
13. Base.
A. Rubber Seals.
B. Ferrule.

PRECOMBUSTION CHAMBER

Tools Needed: 5F8353 Wrench.



REMOVING PRECOMBUSTION CHAMBER

Use the 5F8353 Wrench to remove or install the precombustion chambers. Put 9M3710 Anti-Seize Compound on the threads before installation. Tighten the precombustion chamber to 200 lb.ft. (27.7 mkg).

Position for Precombustion Chambers (With glow plugs)

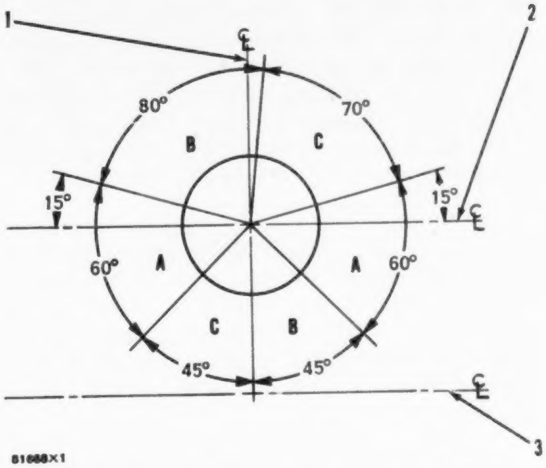


DIAGRAM OF POSITION FOR PRECOMBUSTION CHAMBER

1. Center line of the precombustion chamber that is at a right angle to the center line of the crankshaft. 2. Center line of the precombustion chamber that is parallel to the center line of the crankshaft. 3. Center line of the crankshaft.

Put 1P6442 Gasket, with "4D" on it, on the precombustion chamber. Put 9M3710 Anti-Seize Compound on the threads of the precombustion chamber. Install the precombustion chamber in the cylinder head and tighten to 200 lb.ft. (27.7 mkg). If the opening for the glow plug is not in the "A range", remove the precombustion chamber and 1P6442 Gasket. If the opening for the glow plug was in the "B range" use 1P6441 Gasket with "4J" on it. If the opening for the glow plug was in the "C range" use 5H2579 Gasket with "4C" on it. Put 9M3710 Anti-Seize Compound on the threads of the precombustion chamber. Install the precombustion chamber with the correct gasket and tighten the precombustion chamber to 200 lb.ft. (27.7 mkg).

LUBRICATION SYSTEM

One of the problems in the following list will generally be an indication of a problem in the lubrication system for the engine.

TOO MUCH OIL CONSUMPTION
OIL PRESSURE IS LOW
OIL PRESSURE IS HIGH
TOO MUCH COMPONENT WEAR

TOO MUCH OIL CONSUMPTION

Oil Leakage on Outside of Engine

Check for leakage at the seals at each end of the crankshaft. Look for leakage at the oil pan gasket and all lubrication system connections. Check to see if oil is coming out of the crankcase breather. This can be caused by combustion gas leakage around the pistons. A dirty crankcase breather will cause high pressure in the crankcase, and this will cause gasket and seal leakage.

Oil Leakage Into Combustion Area of Cylinders

Oil leakage into the combustion area of the cylinders can be the cause of blue smoke. There are four possible ways for oil leakage into the combustion area of the cylinders:

1. Oil leakage between worn valve guides and valve stems.
2. Worn or damaged piston rings or dirty oil return holes.
3. There can be a leakage of oil past the ring seals at the impeller end of the turbocharger shaft.
4. Compression ring not installed correctly.

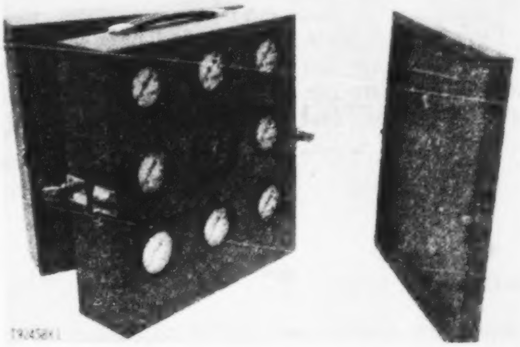
Too much oil consumption can also be the result of using oil with the wrong viscosity. Oil with a thin (low) viscosity can be caused from fuel getting in the crankcase, or by the engine getting too hot.

OIL PRESSURE IS LOW

An oil pressure gauge that has a defect may give an indication of low oil pressure.

When the engine is running at full load rpm with SAE 10 oil, temperature at 200 ± 10°F (93 ± 6°C), the oil pressure measured at the clean side of the oil filter at the oil filter base will be 48 ± 7 psi (3.37 ± 0.49 kg/cm²).

A lower pressure reading, 18 ± 7 psi (1.27 ± 0.49 kg/cm²), is normal at low idling speeds. An 8M2744 Gauge, which is part of 7S8875 Hydraulic Test Box, can be used for checking pressure in the system.



7S8875 HYDRAULIC TEST BOX

Crankcase Oil Level

Check the level of the oil in the crankcase. Add oil if needed. It is possible for the oil level to be too far below the oil pump supply tube. This will result in the oil pump not having the ability to supply enough lubrication to the engine components.

Oil Pump Does Not Work Correctly

The inlet screen of the supply tube for the oil pump can have a restriction. The result will be cavitation and a loss of oil pressure. Air leakage in the supply side of the oil pump will also cause cavitation and loss of oil pressure. If the pressure regulating valve for the system is held in the open (unseated) position, the lubrication system can not get to maximum pressure. Oil pump gears that have too much wear will cause a reduction in oil pressure.

Oil Filter and Oil Cooler Bypass Valves

If the bypass valve for the oil filter is held in the open position (unseated) and the oil filter has a restriction, a reduction in oil pressure will be the result.

The bypass valve is in the oil filter base. The bypass valve will cause the flow of oil to go around the filter elements when there is a reduction to the flow through the elements.

If the oil cooler has a restriction, the oil cooler bypass valve in the oil filter base will open. This will cause the flow of oil to go around the oil cooler.

Too Much Clearance at Engine Bearings or Open, Broken or Disconnected Oil Line or Passage in Lubrication System

Components that are worn and have too much bearing clearance can cause oil pressure to be low. Low oil pressure can also be caused by an oil line or oil passage that is open, broken, or disconnected.

Oil Cooler

Look for a restriction in the oil passage of the oil cooler.

If the oil cooler has a restriction the oil temperature will be higher than normal when the engine is running. The oil pressure of the engine will become low if the oil cooler has a restriction.

OIL PRESSURE IS HIGH

Oil pressure will be high if the bypass valve for the oil pump can not move from the closed position.

TOO MUCH COMPONENT WEAR

When some components of the engine show bearing wear in a short time. the cause can be a restriction in an oil passage. A broken oil passage can also be the cause.

If the gauge for oil pressure shows the correct oil pressure, but a component is worn because it is not getting enough lubrication, look at the passage for oil supply to that component. A restriction in a supply passage will not let enough lubrication get to a component and this will cause early wear.

Turbocharger Component Wear

When the gauge for oil pressure shows the correct oil pressure and bearing failure or wear is present in the turbocharger, check the operation of the turbocharger lubrication valve. The valve can be in the open position and permit oil that is not clean to give lubrication to the turbocharger.

COOLING SYSTEM

This engine has a pressure type cooling system. A pressure type cooling system gives two advantages. The first advantage is that the cooling system can have safe operation at a temperature that is higher than the normal boiling (too hot) point of water. The second advantage is that this type system prevents cavitation (air at inlet of pump) in the water pump. With this type system it is more difficult for an air or steam pocket to form in the cooling system.

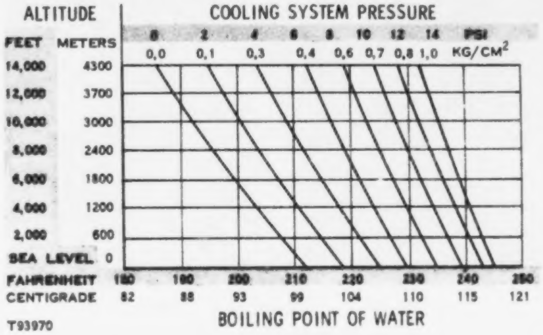
The cause for an engine getting too hot is generally because regular inspections of the cooling system were not done. Make a visual inspection of the cooling system before testing with testing equipment.

VISUAL INSPECTION OF THE COOLING SYSTEM

1. Check coolant level in the cooling system.
2. Look for leaks in the system.
3. Look for bent radiator fins. Be sure that air flow through the radiator does not have a restriction.
4. Inspect the drive belt for the fan.
5. Check for damage to the fan blades.
6. Look for air or combustion gas in the cooling system.
7. Inspect the pressure cap and the sealing surface for the cap. The sealing surface must be clean.
8. Look for large amounts of dirt in the radiator core and on the engine.

TESTING THE COOLING SYSTEM

Remember that temperature and pressure work together. When making a diagnosis of a cooling system problem, temperature and pressure must both be checked. Cooling system pressure will have an effect on cooling system temperatures. For an example, look at the chart to see the effect of pressure and the height above sea level on the boiling point (steam) of water.



Test Tools for Cooling System

Tools Needed: **9S9102 Thermistor Thermometer Group.**
9S7373 Air Meter Group.
1P5500 Portable Phototach Group.
9S8140 Cooling System Pressurizing Pump Group.

9S9102 Thermistor Thermometer Group

The 9S9102 Thermistor Thermometer Group is used in the diagnosis of overheating (engine running too hot) or overcooling (engine running too cool) problems. This group can be used to check the different parts of the cooling system. The complete testing procedure is in Special Instruction (GMG00450).

V ADJ.
OFF
V ADJ.
CATERPILLAR SERVICE TOOL
9S9102
THERMOMETER INPUTS
A14349X1

9S9102 THERMISTOR THERMOMETER GROUP

The locations for making the temperature checks with the probe are listed below:

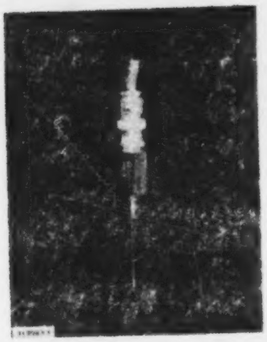


Fig. 1

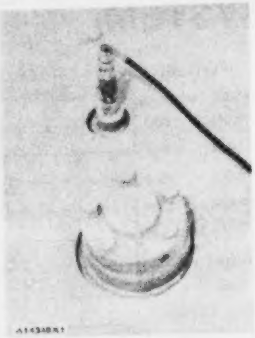


Fig. 2

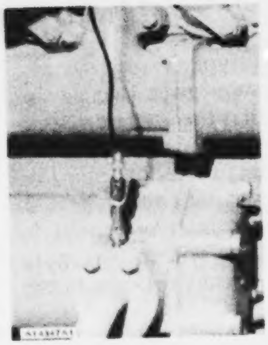


Fig. 3

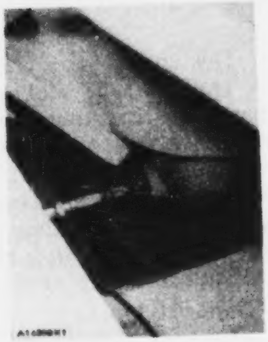


Fig. 4

Fig. 1. Ambient (air temperature away from the machine and not in direct sunlight).

Fig. 2. Top tank (in a pipe plug location in the top tank of the radiator and in the housing for the regulators or in the water manifold).

Fig. 3. Torque converter (oil outlet temperature). Early D8K's may require a hole with 1/8" NPT to be drilled in the outlet tube as shown. Later machines have a tapped hole in the oil cooler and housing.

Fig. 4. Bottom tank (in the drain outlet for the radiator or the pipe plug location in the lower elbow of the radiator).

Be sure the probe is installed in the liquid of the system being tested.

CAUTION: Do not tighten the probe more than 30 lb.ft. (4.1 mkg) torque.

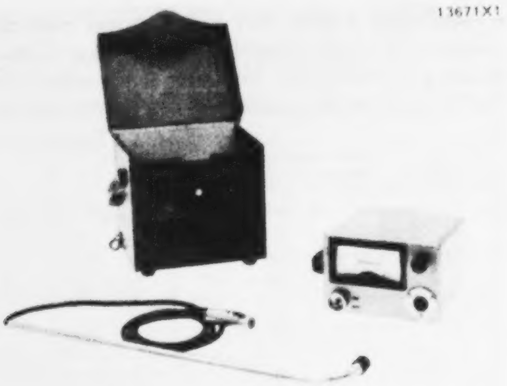
Check temperatures in the locations listed in the chart and make a comparison of these temperatures. Look at the chart to see if these comparisons are within the range in the chart. Make the needed checks if the temperatures are not within the ranges.

NOTE: Illustrations show the use of optional 5P2720 and 5P2725 Adapters (for self-sealing when probes are removed).

PROBE LOCATIONS	TEMPERATURES	PROBLEM	CHECK FOR
Top Tank (Fig. 2) and Ambient (Fig. 1)	Maximum 110°F (61°C) difference.	Overheating	Wrong Gear Selection. Radiator Core with Restriction to Air Flow. Bent Radiator Fins. Low Fan Speed. Damaged Fan Guard. Wrong Blade Position.
Top Tank (Fig. 2) and Bottom Tank (Fig. 4)	Maximum 15°F (8°C) difference.	Not enough Water Flow	Defect in Water Pump. Collapsed Hoses. Restriction in Radiator Core Tubes. Low Coolant Level.
Top Tank (Fig. 2) and Torque Converter Oil Outlet (Fig. 3)	Under normal conditions, temperature difference maximum 40°F (22°C). At stall conditions, normal temperature of torque converter oil 270°F (132°C) for any extended period of time.	Overheating	Wrong Gear Selection. Engine Operated with too Great a Load. Leakage Inside Torque Converter. Low Oil Flow From Torque Converter to Cooler.
Top Tank (Fig. 2) and Regulator Housing (Fig. 2)	Maximum 2°F (1°C) difference with regulators open.	Overcooling	Temperature Regulator will not Close. Regulator Seals Leaking. Coolant Flow Past the Regulator Flange. Low Ambient Temperature with Light Loads.
		Overheating	Temperature Regulators will not Open.

9S7373 Air Meter Group

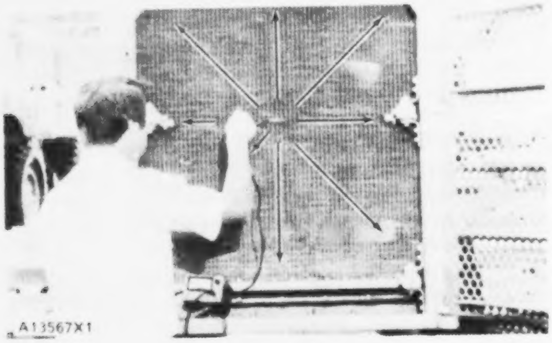
The 9S7373 Air Meter Group is used to check the air flow through the radiator core. Overheating can be caused by installing the wrong fan guard, low fan speed, or a restriction in the radiator core (clogging). The meter will give aid in finding a restriction in the core. The complete testing procedure is in Special Instruction (GMG00203).



9S7373 AIR METER GROUP

⚠ WARNING: When making the checks fasten the transmission in neutral, put the parking brakes on and lower all equipment. Make all checks at engine LOW IDLE and on the side of the radiator opposite the fan. Wear eye protection.

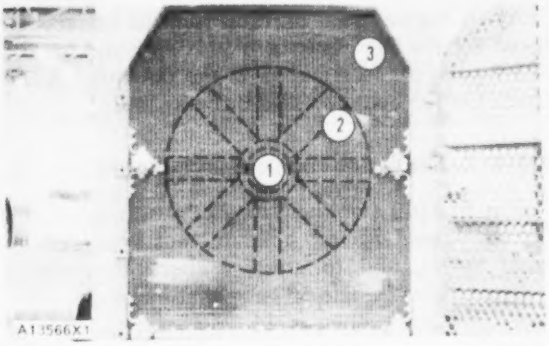
Take readings in a cross and diagonal pattern. Make a comparison of the readings in each line the same distance from the center of the fan. Permit differences for restrictions such as guards, braces and engine components which will cause a change in the rate of air flow.



CHECKING AIR FLOW IN CROSS AND DIAGONAL LINES

The air flow in feet per minute for a clean radiator core on both the D8K Tractor and the 583 Pipelayer must be: (1) Hub; 50 to 200, (2) Blade; 500 to 600, (3) Outside Blade; 300 to 500.

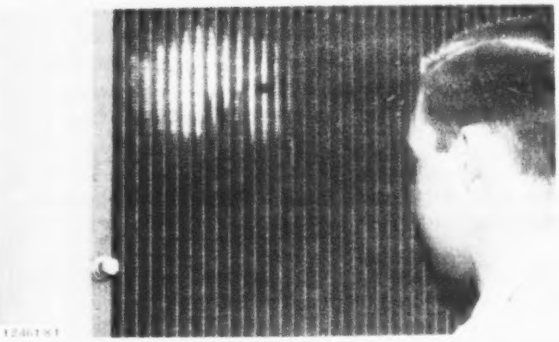
NOTE: All readings are taken at engine LOW IDLE.



AIR FLOW

1. Fan hub area. 2. Fan blade area. 3. Area outside fan blade.

If the readings are not within the ranges, stop the engine, put a strong light behind the core and inspect for a restriction. If the restriction is from dirt remove by steam cleaning. If the restriction is from bent fins use 2H1822 Radiator Fin Comb to make the fins straight.



INSPECTING RADIATOR CORE FOR RESTRICTION

1P5500 Portable Phototach Group

If the radiator core does not have a restriction, check the fan speed with the 1P5500 Portable Phototach Group. The complete testing procedure is in Special Instruction (GMG00819).

1P5500 PORTABLE PHOTOTACH GROUP

At an engine speed of 1280 rpm the correct fan speed for the D8K Tractor is 1210 rpm and for the 583 Pipelayer is 1210 rpm. If the fan speed is less check the fan belts for wear or being loose.

9S8140 Cooling System Pressurizing Pump Group

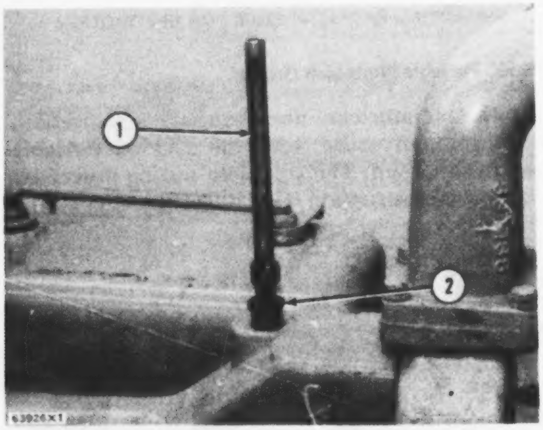
The 9S8140 Cooling System Pressurizing Pump Group is used to test pressure caps and pressure relief valves, and to pressure check the cooling system for leaks. The pressure that makes the pressure relief valve open is 14 to 18 psi (1.0 to 1.3 kg/cm²).

Gauge for Water Temperature

Tools Needed: **9S9102 Thermistor Thermometer Group.**
2F7112 Thermometer.
6B5072 Bushing.

If the engine gets too hot and a loss of coolant is a problem, a pressure loss in the cooling system could be the cause. If the gauge for water temperature shows that the engine is getting too hot, look for coolant leakage. If a place can not be found where there is coolant leakage, check the accuracy of the gauge for water temperature. Use the 9S9102 Thermistor Thermometer Group. This check can also be made by installing a 2F7112 Thermometer (using a 6B5072 Bushing) into the water manifold.

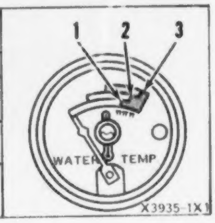
⚠ WARNING: Be careful when working around an engine if it is running.



THERMOMETER INSTALLED
1. 2F7112 Thermometer. 2. 6B5072 Bushing.

Start the engine. Put a cover over part of the radiator or cause a restriction of coolant flow. The reading on the gauge for water temperature should be the same as the reading on the thermometer.

POINTER POSITION	TEST THERMOMETER TEMPERATURE READING	
	F°	C°
1	212 TO 216	99.9 TO 102.1
2	222 TO 226	105.5 TO 107.7
3	232 TO 236	111 TO 113



Filler Cap or Relief Valve

One cause for a pressure loss in the cooling system can be a bad seal on the filler cap or relief valve of the system. Inspect the filler cap and relief valve carefully. Look for damage to the seal or the sealing surface. Any foreign material or deposits on the cap, valve, seal, or sealing surface must be removed.

Water Temperature Regulator

The regulator must be fully open at the following temperature:

4L7615 Regulator	180°F (82°C)
6L5851 Regulator	197°F (92°C)
9S9160 Regulator	185°F (85°C)

Test Procedure:

1. Heat water in a pan until the temperature of the water is correct for opening the regulator according to the chart.
2. Hang the regulator in the pan of water so it is completely under the water. The regulator must not be in contact with the sides or bottom of the pan during the test period.
3. During the test period, move (stir) the water around the inside of the pan to make all the water the same temperature.
4. After 10 minutes at the correct temperature, take the regulator out of the water.
5. Measure immediately the distance the regulator is open. The distance must be .375 in. (9.53 mm) or more.
6. Use a new regulator if the old regulator does not open correctly.

BASIC BLOCK

CONNECTING RODS AND PISTONS

Use the 7B7974 Piston Ring Expander to remove or install piston rings.

Use the 2B8184 Piston Ring Compressor to install pistons into cylinder block.

Tighten the connecting rod bolts in the following step sequence:

1. Put crankcase oil on threads.
2. Tighten both nuts to 75 ± 5 lb.ft. (10.4 ± 0.7 mkg).
3. Put a mark on each nut and cap.
4. Tighten each nut 60° from the mark.

The connecting rod bearings should fit tightly in the bore in the rod. If bearing joints or backs are worn (fretted), check for bore size as this is an indication of wear because of looseness.

CONNECTING ROD AND MAIN BEARINGS

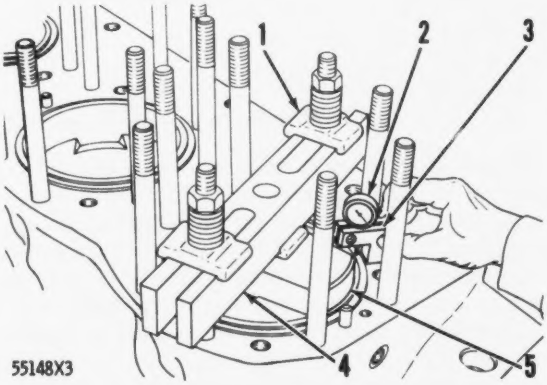
Bearings are available with .025 in. (0.64 mm) and .050 in. (1.27 mm) smaller inside diameter than the original size bearings. These bearings are for crankshafts that have been "ground" (made smaller than the original size).

PROJECTION OF CYLINDER LINER

Tools Needed: **1P2397 Puller Plate.**
8B7548 Push Puller Crossbar and three 3H465 Plates.
8S3140 Cylinder Block Counterboring Tool Arrangement.
1P5510 Liner Projection Tool Group.

1. Make sure that the bore in block and the cylinder liner flange are clean.
2. Use a 1P2397 Puller Plate (5), three 3H465 Plates (1) and the crossbar (4) from the 8B7548 Push Puller, to hold the liner down with stud nuts for the cylinder head.
3. Tighten the nuts to a total of 50 lb.ft. (6.9 mkg). Tighten the nuts evenly in four steps; 5 lb.ft. (0.7 mkg), 15 lb.ft. (2.1 mkg), 25 lb.ft. (3.5 mkg), and then to 50 lb.ft. (6.9 mkg). The distance from bottom edge of the crossbar, to the cylinder block must be the same on both sides of the cylinder liner.
4. Use a 1P5510 Liner Projection Tool Group (2) to measure liner projection. Special Instruction (GMG00623) is included with the tool.
5. Liner projection must be .006 ± .002 in. (0.15 ± 0.05 mm). The maximum difference in height of liners next to each other is .001 in. (0.03 mm). The maximum difference between high and low measurements made at four places around each liner is .001 in. (0.03 mm). Shims are available for adjustment of the liner projection. See the chart.
6. Use the 8S3140 Counterboring Tool Arrangement to bore the block deeper if needed. Maximum depth of the bore is .553 in. (14.05 mm). Special Instruction (FE055228) gives an explanation of the use of the 8S3140 Counterboring Tool Arrangement.

ADJUSTMENT SHIMS FOR LINER PROJECTION				
SHIM THICKNESS, COLOR CODE, AND PART NUMBER				
.007 in. (0.18 mm)	.008 in. (0.20 mm)	.009 in. (0.23 mm)	.015 in. (0.38 mm)	.030 in. (0.76 mm)
BLACK 5S8143	RED 5S8144	GREEN 5S8145	BROWN 5S8146	BLUE 5S8147



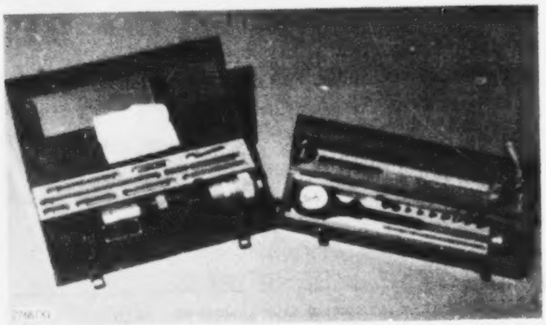
MEASURING LINER PROJECTION

1. 3H465 Plate. 2. Dial indicator. 3. 1P2402 Block. 4. Crossbar. 5. 1P2397 Puller Plate.

CYLINDER BLOCK

Tools Needed: 1P4000 Line Boring Tool Group.
1P3537 Dial Bore Gauge Group.

The bore in the block for main bearings can be checked with the main bearing caps installed without bearings. Tighten the nuts holding the caps to the torque shown in the SPECIFICATIONS, Form No. REG01402. Alignment error in the bores must not be more than .003 in. (0.08 mm). Special Instruction (GMG00503) gives the use of 1P4000 Line Boring Tool Group to machine the main bearing bores. 1P3537 Dial Bore Gauge Group can be used to check the size of the bores. Special Instruction (GMG00981) is with the group.



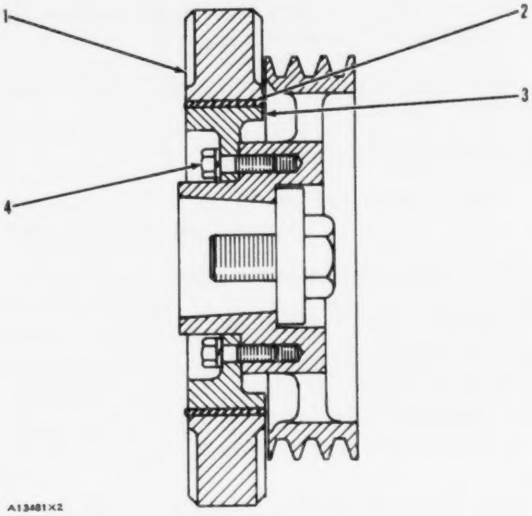
1P3537 DIAL BORE GAUGE GROUP

FLYWHEEL

Heat the ring gear to install it. Do not heat to more than 600°F (315°C). Install the ring gear so the chamfer on the gear teeth is next to the starter pinion when the flywheel is installed.

VIBRATION DAMPER

Damage to or failure of the damper will cause an increase in vibrations and can result in damage to the crankshaft.



VIBRATION DAMPER

1. Flywheel ring. 2. Rubber ring. 3. Inner hub. 4. Bolt.

The damper needs replacement when the holes for the bolts have wear and the fit between the bolts and the holes is loose.

ELECTRICAL SYSTEM

Most of the testing of the electrical system can be done on the engine. The wiring insulation must be in good condition, the wire and cable connections clean and tight and the battery fully charged. If the on engine test shows a defect in a component, remove the component for more testing.

BATTERY (ELECTROLYTE CAPACITY 15.2 QTS/BATTERY)

Tools Needed: 9S1990 Battery Charger Tester.

The battery circuit is an electrical load on the charging unit. The load is variable because of the condition of the charge in the battery. Damage to the charging unit will result, if the connections, (either positive or negative) between the battery and charging unit are broken while the charging unit is charging. This is because the battery load is lost and there is an increase in charging voltage.

High voltage will damage, not only the charging unit but also the regulator and other electrical components.

CATERPILLAR

9S1990 BATTERY CHARGER TESTER

⚠ WARNING: Never disconnect any charging unit circuit or battery circuit cable from battery when the charging unit is producing a charge.

Load test a battery that does not hold a charge when in use. To do this, put a resistance, across the battery main connections (terminals). For a 6 volt battery, put a resistance of two times the ampere/hour rating of the battery. For a 12 volt battery, put a resistance of three times the ampere/hour rating. Let the resistance remove the charge (discharge the battery) for 15 seconds. Immediately test the battery voltage. A 6 volt battery in good condition will test 4.5 volts; a 12 volt battery in good condition will test 9 volts.

The Special Instruction (GEG00058) with the 9S1990 Charger Tester gives the battery testing procedure.

CHARGING SYSTEM

The condition of charge in the battery at each regular inspection will show if the charging system is operating correctly. An adjustment is necessary when the battery is always in a low condition of charge or a large amount of water is needed (one ounce per cell per week or every 50 service hours).

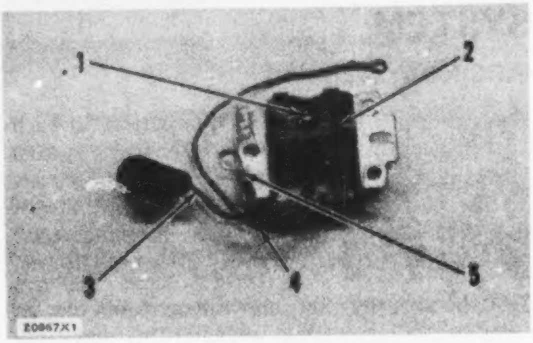
Test the charging units and voltage regulators on the engine, when possible, using wiring and components that are a permanent part of the system. Off the engine (bench) testing will give an operational test of the charging unit and voltage regulator. This testing will give an indication of needed repair. Final testing will give proof that the units are repaired to their original operating condition.

Before starting on the engine testing, the charging system and battery must be checked. See the following Steps.

1. Battery must be at least 75% (1.240 Sp. Gr.) full charged and held tightly in place. The battery holder must not put too much stress on the battery.
2. Cables between the battery, starter and engine ground must be the correct size. Wires and cables must be free of corrosion and have cable support clamps to prevent stress on battery connections (terminals).
3. Wires, junctions, switches and panel instruments that have direct relation to the charging circuit must give proper circuit control.
4. Inspect the drive components for the charging unit to be sure they are free of grease and oil and are able to drive the load of the charging unit.

Alternator Regulator (Prestolite)

The regulator components are sealed in an insulation of epoxy. The regulator is an electronic component with no moving parts (solid state) and has an adjustment screw (1) on the back. This voltage adjustment screw is used to meet different operating needs at different times of the year. An increase or decrease by .5 volts from the normal (N) setting is made by removing the regulator and changing the position of the adjustment screw and washer. An increase to the voltage will be made by moving the screw and washer to the "H" position (2).

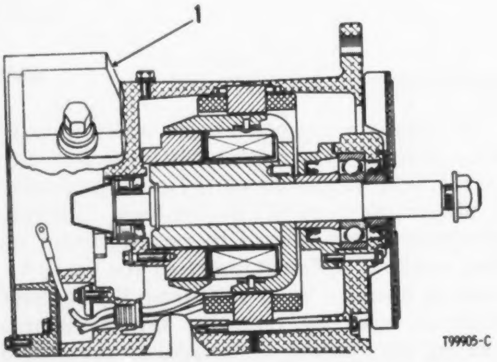


ALTERNATOR REGULATOR

1. Adjustment screw with washer. 2. High output position. 3. Green wire to field terminal of the alternator (F). 4. Orange wire to battery. 5. Black wire to ground.

Alternator Regulator (Delco-Remy)

When the alternator is charging the battery too much or not enough, an adjustment can be made to the alternator regulator. Remove the plug from the cover of the alternator regulator and turn the inside adjustment with a screwdriver. Turn the adjustment one or two notches to change the alternator charging rate.

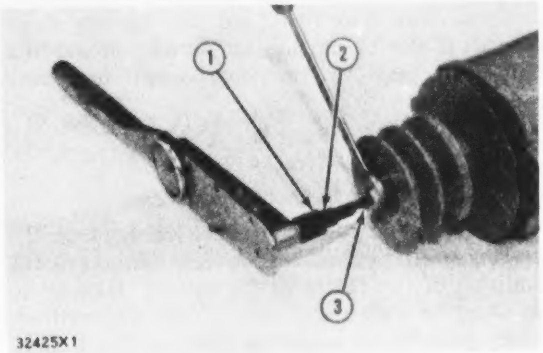


ALTERNATOR REGULATOR

1. Adjustment screw, on other side of alternator from output terminal.

5S9088 Alternator; Pulley Nut Tightening

Tighten the nut holding the pulley to a torque of 75 ± 5 lb.ft. (10.4 ± 0.7 mkg) with the tools shown.



ALTERNATOR PULLEY INSTALLATION

1. 8S1588 Adapter (½" female to 3/8" male). 2. 8S1590 Socket (5/16"-3/8" drive). 3. 1P2977 Tool Group. 8H8555 Socket (15/16"-½" drive) not shown.

STARTING SYSTEM

Use a D. C. Voltmeter to find starting system components which do not work.

Move the starting control switch to activate the starter solenoid. Starter solenoid operation can be heard as the pinion of the starter motor is engaged with the ring gear on the engine flywheel. The solenoid operation also closes the electric circuit to the motor. Connect one lead of the voltmeter to the solenoid connection (terminal) that is fastened to the motor. Put the other lead to a good ground. Activate the starter solenoid and look at the voltmeter. A reading of battery voltage shows the problem is in the motor. The motor must be removed for further testing. No reading on the voltmeter shows that the solenoid contacts do not close. This is an indication of the need for repair to the solenoid or an adjustment to be made to the starter pinion clearance. Pinion clearance is .36 in. (9.1 mm).

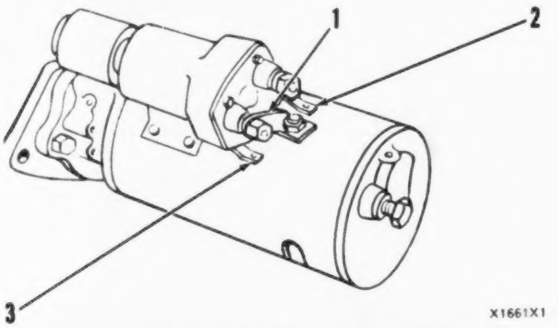
If the solenoid for the starting motor will not operate, it is possible that the current from the battery is not getting to the solenoid. Fasten one lead of the voltmeter to the connection (terminal) for the battery cable on the solenoid. Put the other lead to a good ground. No voltmeter reading shows there is a broken circuit from the battery. Further testing is necessary when there is a reading on the voltmeter.

Further test by fastening one voltmeter lead to the connection (terminal) for the small wire at the solenoid and the other lead to the ground. Look at the voltmeter and activate the starter solenoid. A voltmeter reading shows that the problem is in the solenoid. No voltmeter reading shows that the problem is in the starter switch or wiring. Fasten one lead of the voltmeter to the battery wire connection of the starter switch and put the other lead to a good ground. A voltmeter reading indicates a failure in the switch.

A starting motor that operates too slow can have an overload because of too much friction in the engine being started. Slow operation of the starting motor can also be caused by shorts, loose connections, and/or dirt in the motor.

STARTING MOTOR (1P9182)	24 VOLTS
Rotation (when seen from drive end)	CW
No Load Test:	
Volts	20
Min. amp. (with solenoid)	140
Max. amp. (with solenoid	170
Minimum rpm	5500
Maximum rpm	7500

Pinion Clearance Adjustment (Delco-Remy)

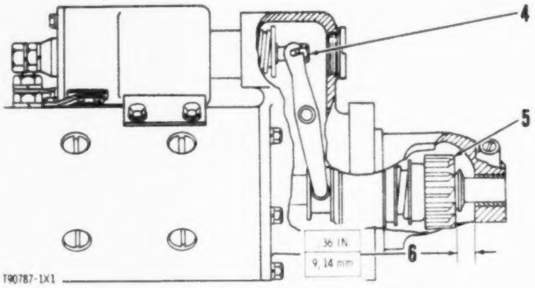


CONNECTION FOR CHECKING PINION CLEARANCE

1. Connector from MOTOR terminal on solenoid to motor. 2. SW terminal. 3. Ground terminal.

Whenever the solenoid is installed, make an adjustment of the pinion clearance. The adjustment can be made with the starting motor removed.

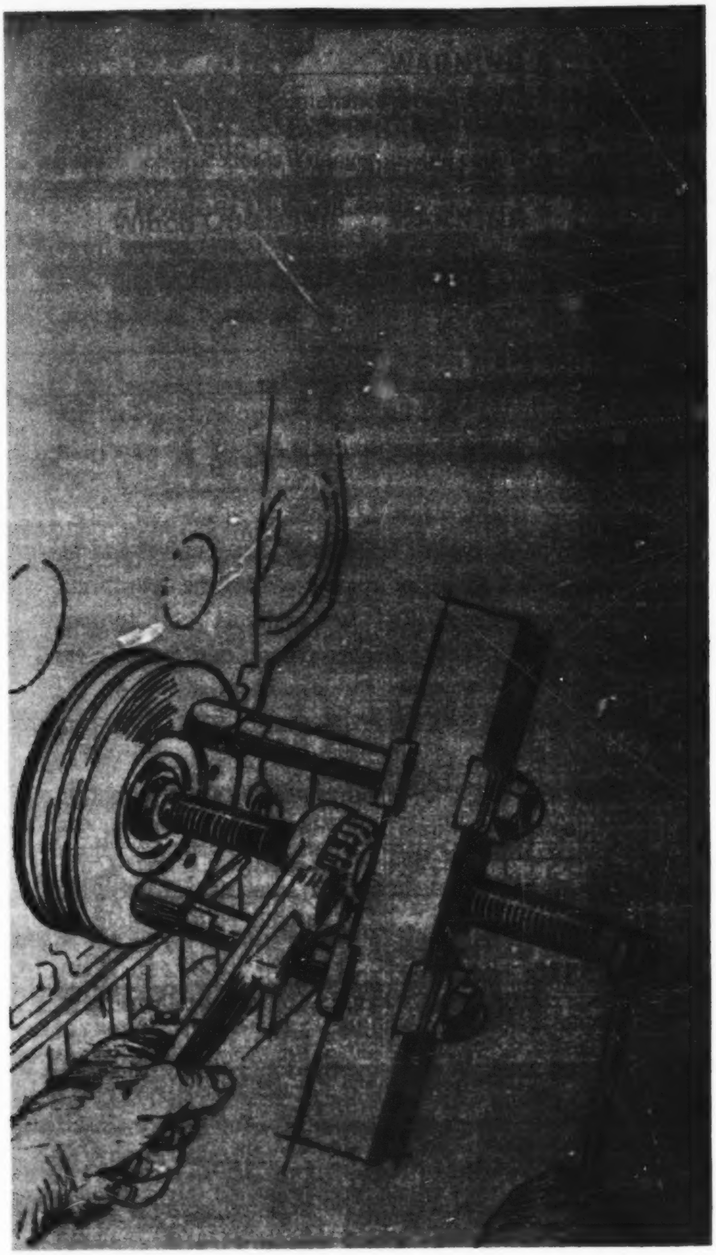
1. Install the solenoid without connector (1) from the MOTOR connection (terminal) on solenoid to the motor.
2. Connect a battery, of the same voltage as the solenoid, to the terminal (2), marked SW.
3. Connect the other side of battery to ground terminal (3).



PINION CLEARANCE ADJUSTMENT

4. Shaft nut. 5. Pinion. 6. Pinion clearance.

4. Connect for a moment, a wire from the solenoid connection (terminal) marked MOTOR to the ground connection (terminal). The pinion will shift to crank position and will stay there until the battery is disconnected.
5. Push the pinion toward commutator end to remove free movement.
6. Pinion clearance (6) must be .36 in. (9.1 mm).
7. Pinion clearance adjustment is made by removing plug and turning nut (4).



DISASSEMBLY AND ASSEMBLY

D342 VEHICULAR ENGINE FOR D8K TRACTORS

SERIAL NUMBERS

ENGINE	TRACTOR
17S1-UP	76V1-UP
17S1-UP	77V1-UP
50V1-UP	66V1-UP

INTRODUCTION

This publication has instructions and procedures for the subject on the front cover. The information, specifications, and illustrations in this publication are on the basis of information that was current at the time this issue was written.

The "Alphabetical and Service Index" is a list of all components and service operations found in this manual. It gives page numbers and also an operation number for each component.

All operations in the column "Component Operation" are removal and installation instructions, unless other descriptions are given for the operations. The numbers under the column "Operation" are numbers given to each operation for use under the column "Other Needed Operations" which gives all other component operations by number that are necessary to do the respective job.

Correct operation, maintenance, test and repair procedures will give this product a long service life. Before starting a test, repair or rebuild job, the serviceman must read the respective sections of the Service Manual, and know all the components he will work on.

Your safety, and the safety of others, is at all times very important. When you see this symbol ⊕ or this symbol ⚠ in the manual, you must know that caution is needed for the procedure next to it. The symbols are warnings. To work safely, you must understand the job you do. Read all instructions to know what is safe and what is not safe.

It is very important to know the weight of parts. Do not lift heavy parts by hand. Use a hoist. Make sure heavy parts have a good stability on the ground. A sudden fall can cause an accident. When lifting part of a machine, make sure the machine has blocks at front and rear. Never let the machine hang on a hoist, put blocks or stands under the weight.

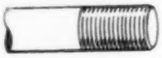
When using a hoist, follow the recommendation in the manual. Use correct lift tools as shown in illustrations to get the correct balance of the component you lift. This makes your work safer at all times.

GENERAL TIGHTENING TORQUE FOR BOLTS, NUTS AND TAPERLOCK STUDS

The following charts give the standard torque values for bolts, nuts and taperlock studs of SAE Grade 5 or better quality. Exceptions are given in the component Disassembly and Assembly.

THREAD DIAMETER		STANDARD TORQUE	
inches	millimeters	lb. ft.	mkg

Standard thread



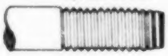
Use these torques for bolts and nuts with standard threads.

1/4	6.35	9 ± 3	1.24 ± 0.4
5/16	7.94	18 ± 5	2.5 ± 0.7
3/8	9.53	32 ± 5	4.4 ± 0.7
7/16	11.11	50 ± 10	6.9 ± 1.4
1/2	12.70	75 ± 10	10.4 ± 1.4
9/16	14.29	110 ± 15	15.2 ± 2.0
5/8	15.88	150 ± 20	20.7 ± 2.8
3/4	19.05	265 ± 35	36.6 ± 4.8
7/8	22.23	420 ± 60	58.1 ± 8.3
1	25.40	640 ± 80	88.5 ± 11.1
1 1/8	28.58	800 ± 100	110.6 ± 13.8
1 1/4	31.75	1000 ± 120	138 ± 16.6
1 3/8	34.93	1200 ± 150	166 ± 20.7
1 1/2	38.10	1500 ± 200	207 ± 27.7

Use these torques for bolts and nuts on hydraulic valve bodies.

5/16	7.94	13 ± 2	1.8 ± 0.3
3/8	9.53	24 ± 2	3.3 ± 0.3
7/16	11.11	39 ± 2	5.4 ± 0.3
1/2	12.70	60 ± 3	8.3 ± 0.4
5/8	15.88	118 ± 4	16.3 ± 0.5

Taperlock stud



Use these torques for studs with Taperlock threads.

1/4	6.35	5 ± 2	0.69 ± 0.3
5/16	7.94	10 ± 3	1.4 ± 0.4
3/8	9.53	20 ± 3	2.8 ± 0.4
7/16	11.11	30 ± 5	4.1 ± 0.7
1/2	12.70	40 ± 5	5.5 ± 0.7
9/16	14.29	60 ± 10	8.3 ± 1.4
5/8	15.88	75 ± 10	10.4 ± 1.4
3/4	19.05	110 ± 15	15.2 ± 2.0
7/8	22.23	170 ± 20	23.5 ± 2.8
1	25.40	260 ± 30	35.9 ± 4.1
1 1/8	28.58	320 ± 30	44.2 ± 4.1
1 1/4	31.75	400 ± 40	55 ± 5.5
1 3/8	34.93	480 ± 40	66 ± 5.5
1 1/2	38.10	550 ± 50	76 ± 7

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*Operation location in POWER TRAIN section of DISASSEMBLY AND ASSEMBLY (torque divider or flywheel clutch, remove and install)

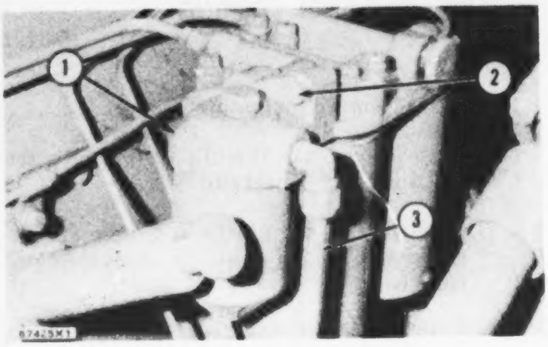
**Operation location in POWER TRAIN section of DISASSEMBLY AND ASSEMBLY (dash and universal joint)

⚠ **DISCONNECT BATTERIES BEFORE PERFORMANCE OF ANY SERVICE WORK**

PRIMARY FUEL FILTER, FUEL PRIMING PUMP

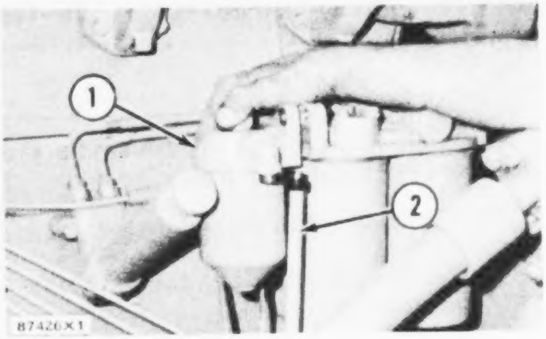
REMOVE PRIMARY FUEL FILTER 11–1260

1. Turn the valve for fuel supply to "OFF" position. The location of the valve is on the bottom of the fuel tank.
2. Disconnect fuel inlet tube (3) from the primary fuel filter.
3. Remove two bolts (2). Remove the primary fuel filter (1).



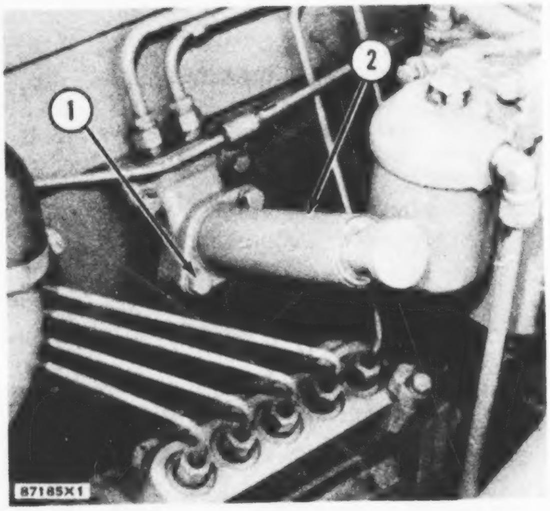
INSTALL PRIMARY FUEL FILTER 12–1260

1. Put the primary fuel filter (1) in position on the fuel filter base. Install the two bolts that hold it.
2. Connect fuel inlet tube (2) to the primary fuel filter.
3. Turn the valve for fuel supply to "ON" position.



REMOVE FUEL PRIMING PUMP 11–1258

1. Turn the valve for fuel supply to "OFF" position. The location of the valve is on the bottom of the fuel tank.
2. Remove two bolts (1). Remove the fuel priming pump (2).



INSTALL FUEL PRIMING PUMP 12–1258

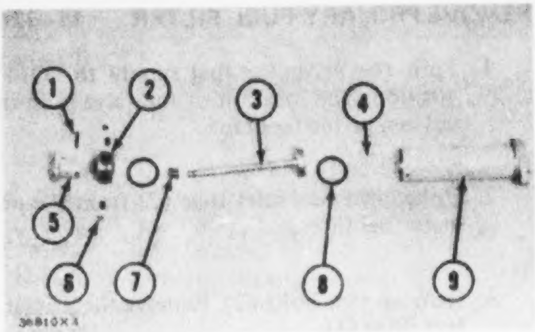
1. Install the fuel priming pump (2). Install the two bolts that hold it.
2. Turn the valve for fuel supply to the "ON" position.

FUEL PRIMING PUMP

DISASSEMBLE FUEL PRIMING PUMP 15–1258

start by:
a) remove fuel priming pump

1. Push in on pins (6) and pull the rod assembly out of the barrel (9).
2. Remove roll pin (1) from handle (5). Remove the handle, cap (2), and spring (7) from rod (3).
3. Remove seal (8) and ring (4) from the rod.

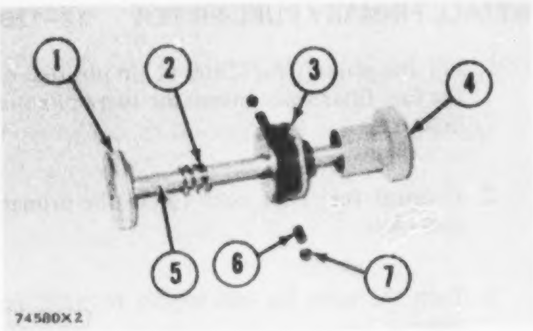


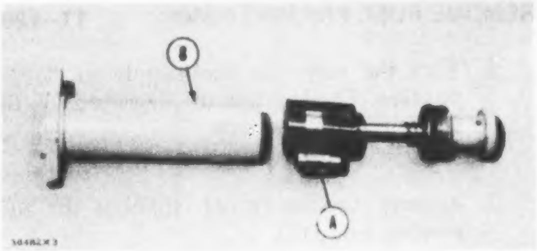
ASSEMBLE FUEL PRIMPING PUMP 16–1258

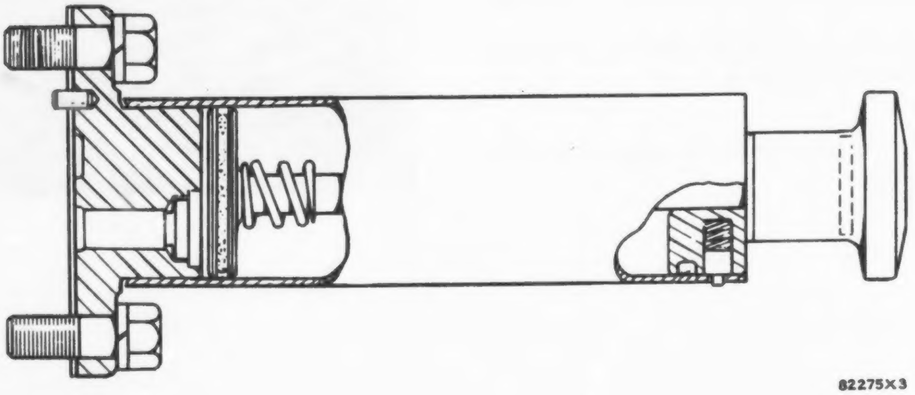
	Tools Needed	A
9S289	Compressor	1

1. Install spring (2), cap (3), and handle (4) on rod (5). Install the roll pin.
2. Install seal and ring (1) on the rod.
3. Put clean diesel fuel on the inside walls of the barrel (8).
4. Install tool (A) on the seal and ring of the rod.
5. Install the rod in the barrel.
6. Put springs (6) and pins (7) in the cap. Hold the pins in while installing cap in the barrel.

end by:
a) install fuel priming pump



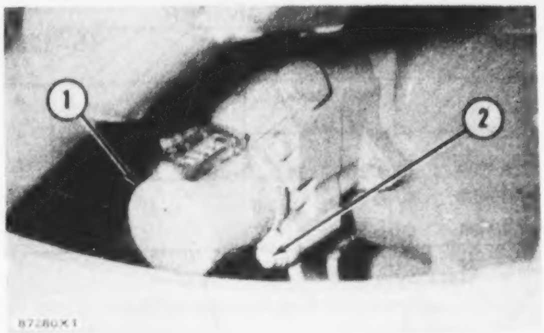




SERVICE METER, FUEL TRANSFER PUMP

REMOVE SERVICE METER 11–7478

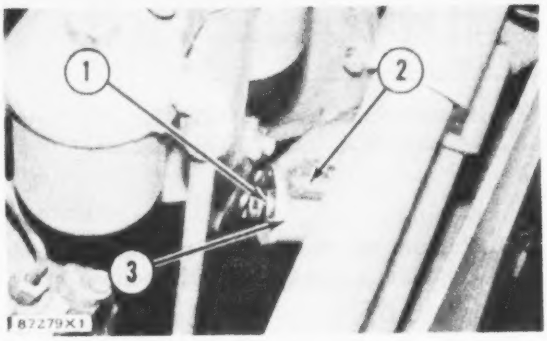
1. Remove two bolts (2) and clamps. Remove the service meter (1) from the fuel transfer pump.



INSTALL SERVICE METER 12–7478

1. Put a light amount of oil on O-ring seal (1). Install service meter (3) in the fuel transfer pump. Make sure the shaft of the service meter engages in the groove (slot) in the shaft of the fuel transfer pump. Make sure the window (2) is toward the top.

2. Install the two bolts and clamps that hold the service meter. Tighten the bolts to a torque of 8 ± 2 lb.ft. (1.1 ± 0.3 mkg).



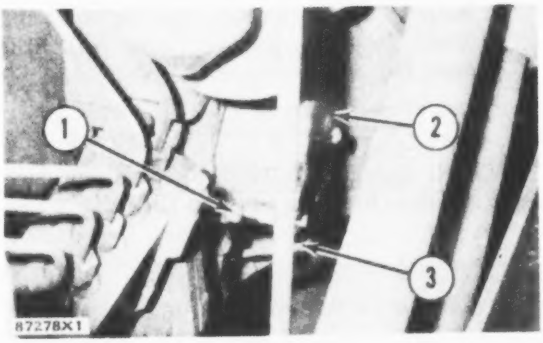
REMOVE FUEL TRANSFER PUMP 11–1256

start by:
- a) remove service meter

1. Turn the valve for fuel supply to "OFF" position. The location of the valve is at the bottom of the fuel tank.

2. Disconnect bleed line (3) from the bottom of the fuel transfer pump.

3. Remove two bolts (1). Remove the fuel transfer pump (2).

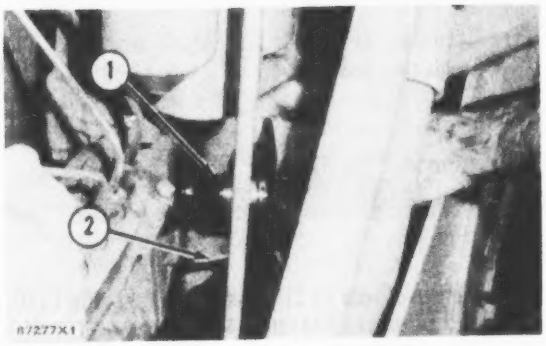


INSTALL FUEL TRANSFER PUMP 12–1256

1. Put the fuel transfer pump (1) in position on the housing for accessory drive. Install the two bolts that hold it.

2. Connect the bleed line (2) to the bottom of the fuel transfer pump.

end by:
- a) install service meter

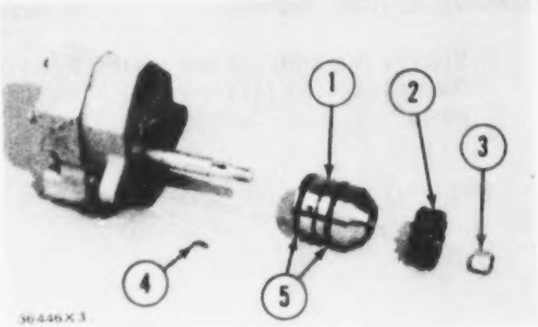


FUEL TRANSFER PUMP

DISASSEMBLE FUEL TRANSFER PUMP 15–1256

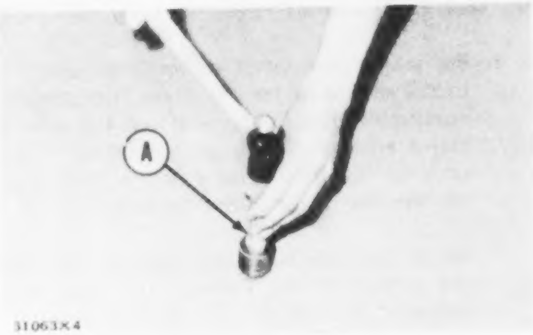
Tools Needed		A
1P529	Handle	1
1P528	Extension Tube	1
1P457	Drive Plate	1
1P454	Drive Plate	1

start by:
a) remove fuel transfer pump

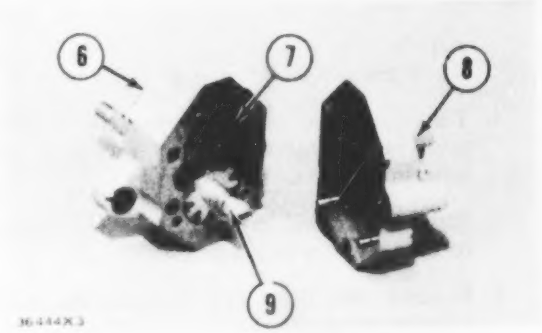


1. Remove nut (3) and gear (2). Remove key (4) from shaft.

2. Remove cage assembly (1). Remove O-ring seals (5) from the cage assembly.



3. Remove the bearing and two lip type seals from the cage assembly with tooling (A).

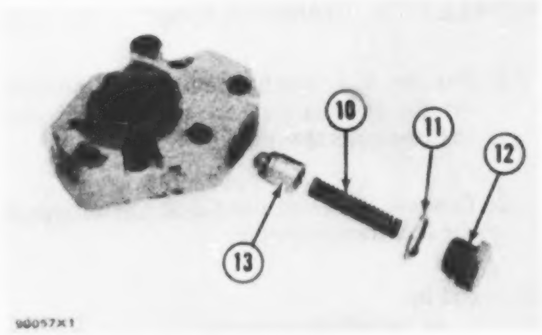


4. Remove the screws that hold the cover and body together. Remove cover (8) from body (6).

CAUTION: Use caution to prevent causing damage to surfaces (B) of the cover and body.

5. Remove the lip type seal from the cover.

6. Remove gear (7) and shaft assembly (9) from the body.



7. Remove the bearing from the body with tooling (A).

8. Remove bolt (12), gasket (11), spring (10), and plunger (13) from the cover.

FUEL TRANSFER PUMP

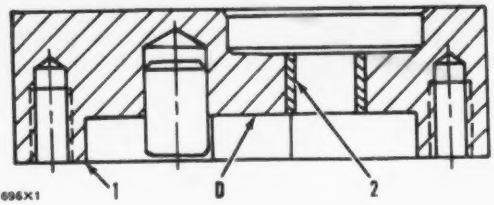
ASSEMBLE FUEL TRANSFER PUMP 16–1256

Tools Needed		A	B	C
1P529	Handle	1	1	
1P459	Drive Plate	1		
1P454	Drive Plate	1	1	
1P462	Drive Plate		1	
9S8102	Seal Tamping Tool Guide			1

1. Clean all parts thoroughly before assembling the transfer pump.
2. Install bearing (2) in body (1) with tooling (A). Make sure the face of the bearing is not beyond surface (D).
3. Put a thin layer of 8S6747 Gasket Sealer (Permatex No. 3) on the outside diameter of seal (4). Install the seal in cover (3) with tooling (B). Make sure dimension (E) is .45 in. (11.4 mm). Make sure the rubber lip of the seal is toward surface (F). Put a light amount of clean diesel fuel on the rubber lip of the seal.
4. Install the shaft assembly and gear in the body.
5. Put a thin layer of 8S6747 Gasket Sealer (Permatex No. 3) on the surface of the body that makes contact with the cover.

CAUTION: Make sure the Permatex does not get on the inner surfaces of the transfer pump.

6. Install the cover on the body. Install the screws that hold the cover and body together.
7. Install seals (6) and (7) in cage with tooling (B). Make sure dimension (G) is .12 in. (3.0 mm). Make sure dimension (H) is .58 in. (14.7 mm). Make sure the rubber lip of seal (7) is toward the face (J) of the cage. Make sure the rubber lip of seal (6) is opposite of face (J). Put a light amount of oil on the rubber lips of seals (6) and (7).
8. Install bearing (5) in the cage with tooling (A).



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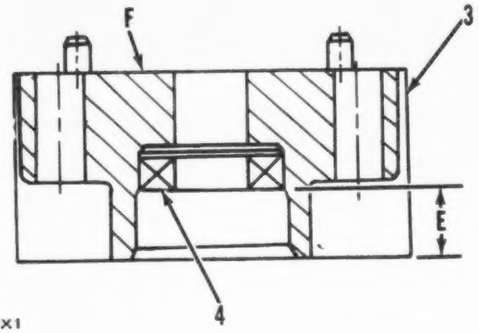

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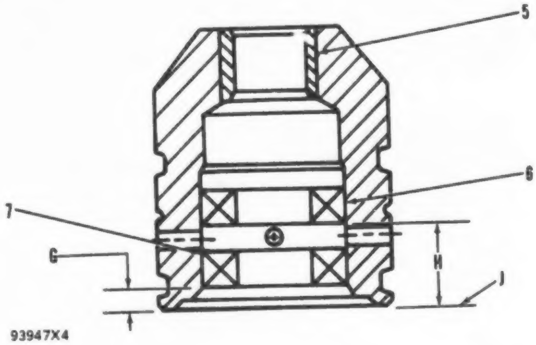

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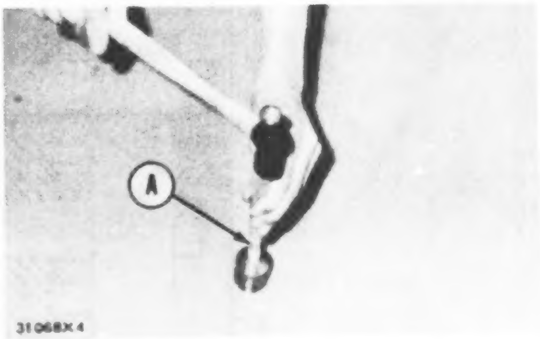

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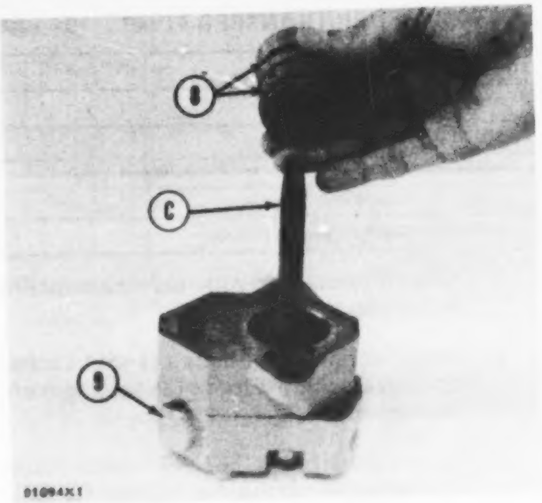
FUEL TRANSFER PUMP

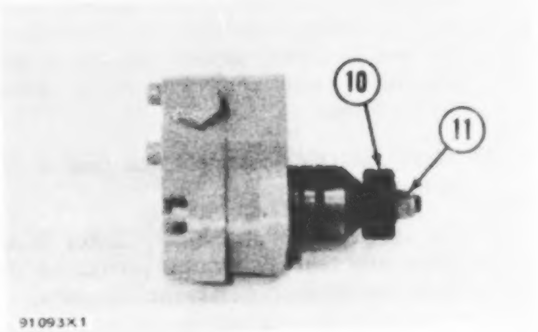
9. Install the plunger, spring, gasket, and bolt (9) in the cover. Tighten the bolt to a torque of 40 ± 5 lb.ft. (5.5 ± 0.7 mkg).

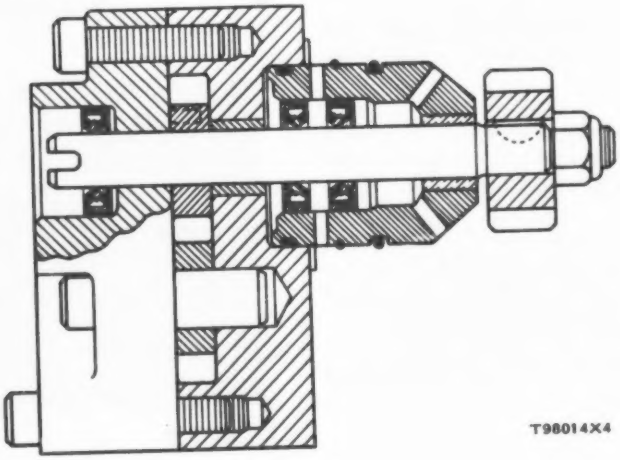
10. Install O-ring seals (8) on the cage.



11. Install tool (C) over the end of the shaft assembly. Install the cage over the shaft assembly.

12. Install the key in the shaft assembly. Install gear (10) and nut (11) on the shaft assembly. Tighten the nut to a torque of 22 ± 5 lb.ft. (3.0 ± 0.7 mkg).





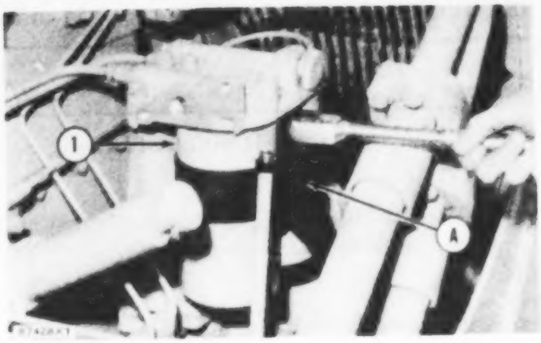
FUEL FILTER BASE

REMOVE FUEL FILTER BASE 11–1262

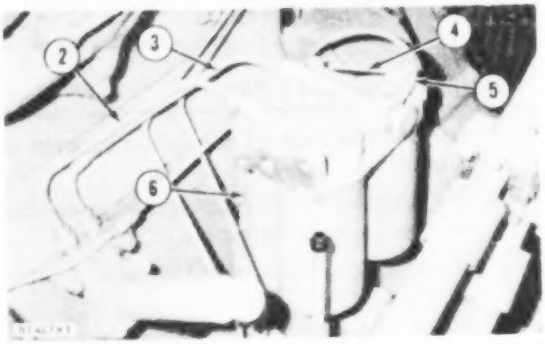
	Tools Needed	A
2P8250	Strap Wrench	1

start by:
a) remove primary fuel filter

1. Remove the two filters (1) with tool (A).



2. Disconnect fuel inlet tube (3) and fuel outlet line (2) from the base. Disconnect gauge tube (4) for fuel pressure from the base. Disconnect bleed line (5) from the base.

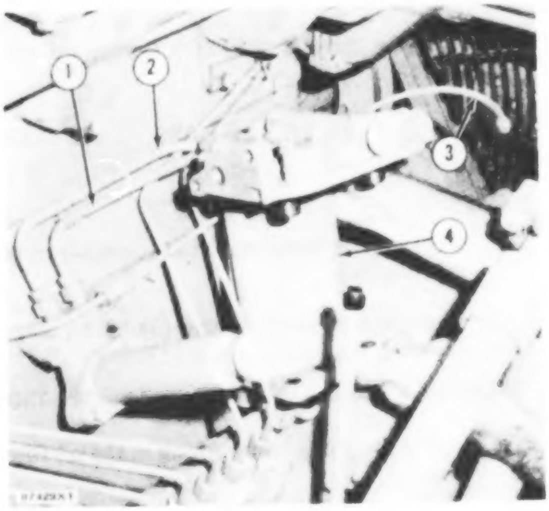


3. Remove the bolts that hold the fuel filter base to the housing for accessory drive. Remove the fuel filter base (6).

INSTALL FUEL FILTER BASE 12–1262

	Tools Needed	A
2P8250	Strap Wrench	1

1. Put the fuel filter base (4) in position on the housing for accessory drive. Install the bolts that hold it.
2. Install the two filters on the base with tool (A).
3. Connect bleed line (3) to the base. Connect the gauge tube for fuel pressure to the base. Connect fuel inlet tube (1) and fuel outlet tube (2) to the base.
4. Remove the air from the fuel system. See PRIMING THE FUEL SYSTEM in LUBRICATION AND MAINTENANCE GUIDE.



NOTE: Install the primary fuel filter before doing Step 4.

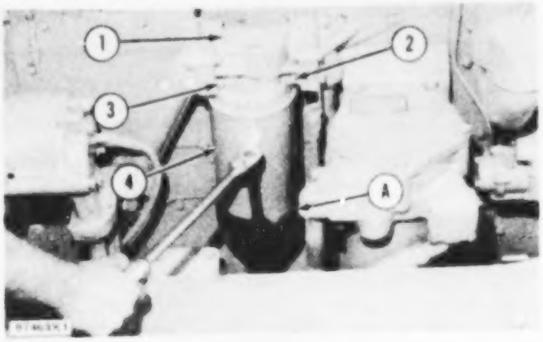
end by:
a) install primary fuel filter

OIL FILTER BASE

REMOVE OIL FILTER BASE 11–1306

	Tools Needed	A
2P8250	Strap Wrench	1

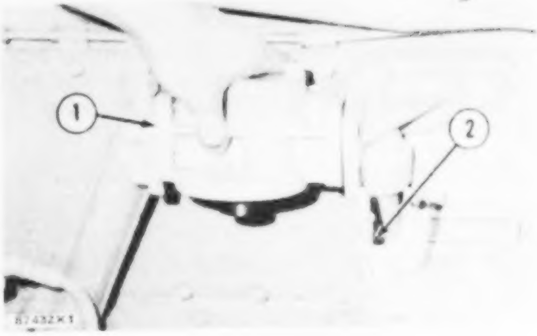
1. Remove oil filter (4) with tool (A).
2. Remove the nuts (2) and bolts (3) that hold the oil filter base to its supports.
3. Remove oil filter base (1).



INSTALL OIL FILTER BASE 12–1306

	Tools Needed	A
2P8250	Strap Wrench	1

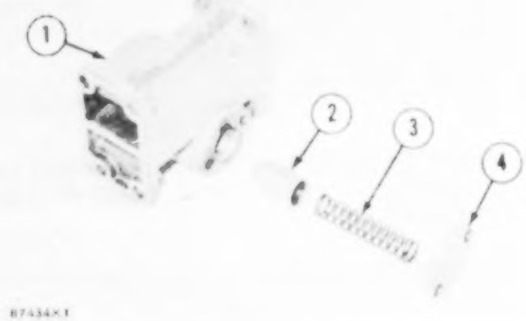
1. Put oil filter base (1) in position between its supports.
2. Put guide tube (2) for oil level gauge in position on the right support.
3. Install the nuts and bolts that hold the tube and base to the supports.
4. Put clean engine oil on the oil filter gasket. Install the oil filter on the base until the gasket makes contact with the base. Tighten the filter three-fourths of a turn more with tool (A).



DISASSEMBLE OIL FILTER BASE 15–1306

start by:
a) remove oil filter base

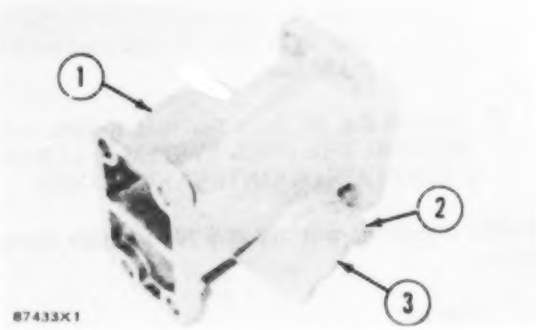
1. Remove the bolts that hold cover (4) to the oil filter base.
2. Remove the cover, spring (3), and plunger (2) from the oil filter base (1).



ASSEMBLE OIL FILTER BASE 16–1306

1. Install the plunger and spring in the oil filter base (1).
2. Put cover (3) in position on the oil filter base and install bolts (2) that hold it.

end by:
a) install oil filter base



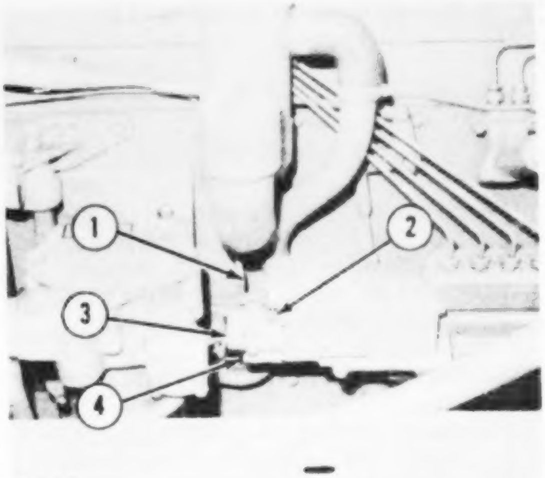
FUEL RATIO CONTROL

REMOVE FUEL RATIO CONTROL 11–1278

1. Remove lockwire (2) from the bolts for the governor and fuel ratio control.

2. Disconnect pressure line (1) from the fuel ratio control.

3. Move the governor control lever to the "OFF" (shutoff) position. Remove bolts (4). Pull out and down on the fuel ratio control to remove the bolt of the fuel ratio control from the groove (slot) in the collar for the governor. Remove the fuel ratio control (3).



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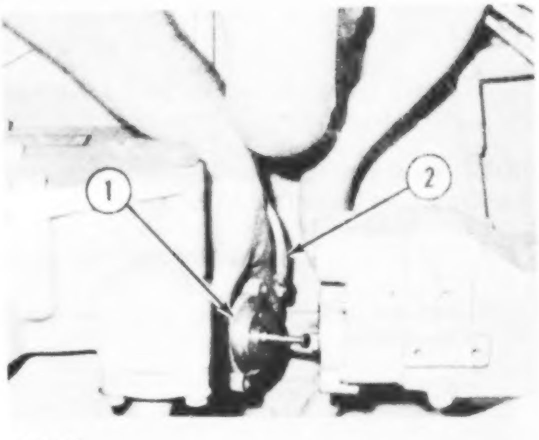
INSTALL FUEL RATIO CONTROL 12–1278

1. Make sure the governor control lever is in the "OFF" (shutoff) position. Install the fuel ratio control (1). Make sure the bolt of the fuel ratio control engages in the groove (slot) in the collar for the governor. Install the bolts that hold the fuel ratio control to the governor.
2. Connect pressure line (2) to the fuel ratio control.
3. Install a new lockwire and seal through the bolts for the governor and fuel ratio control.
4. Make an adjustment to the fuel ratio control. See FUEL RACK SETTING in TESTING AND ADJUSTING SECTION.



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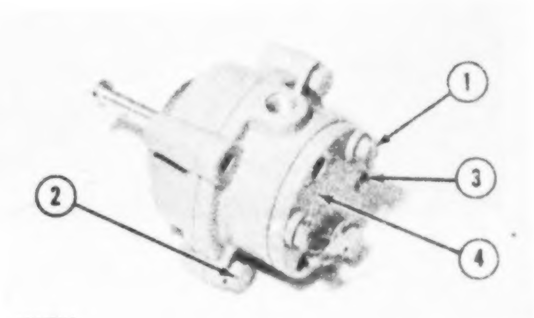
DISASSEMBLE FUEL RATIO CONTROL 15–1278

start by:
a) remove fuel ratio control

1. Remove lockwire (4). Remove three bolts (1) and cover (3).



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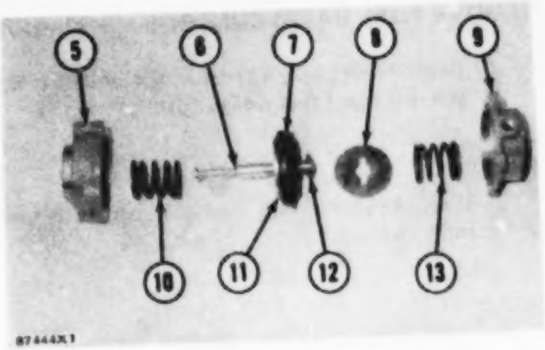
2. Remove two bolts (2).

FUEL RATIO CONTROL

3. Remove cover (9) and spring (13).



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4. Remove bolt (6), retainer (11), diaphragm (7), and washer (8) as a unit from housing (5). Remove spring (10). Remove dowel (12) from the bolt. Remove the washer, diaphragm, and retainer from the bolt.

ASSEMBLE FUEL RATIO CONTROL 16–1278

1. Install retainer (4), diaphragm (12), and washer (9) on bolt (7). Install dowel (6) through the hole in the bolt.

2. Install spring (5) and the bolt in the housing (8).

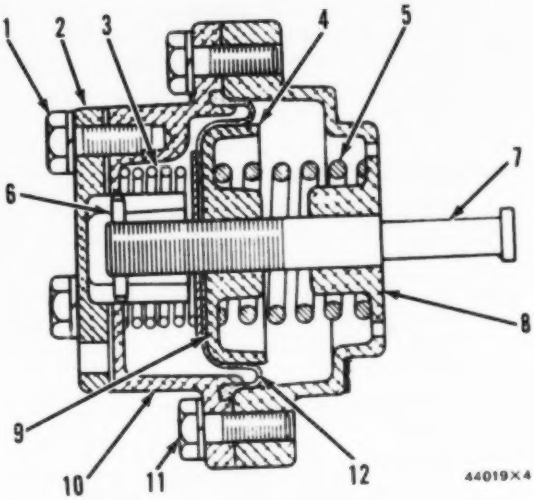
3. Install spring (3) over the bolt. Install cover (10) and the bolts (11) that hold it.

NOTE: Make sure the outer edge of the diaphragm is in the groove in the face of the cover.

4. Install cover (2) and bolts (1) that hold it.

5. Install a new lockwire and seal through the three bolts.

end by:
a) install fuel ratio control



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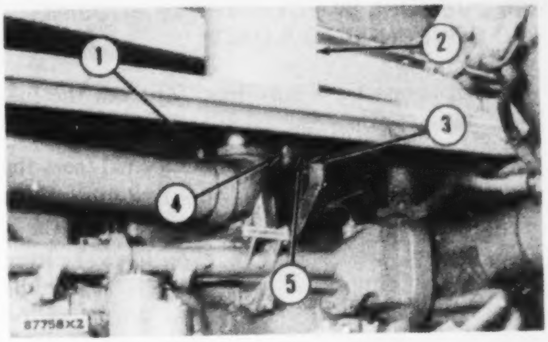
HOOD

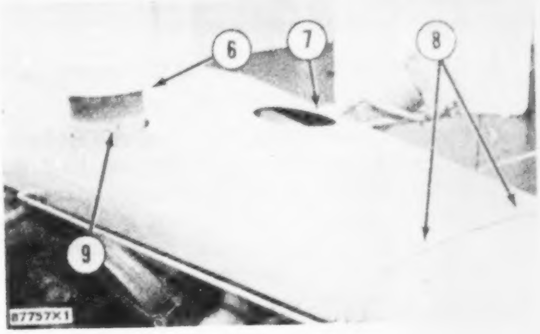
REMOVE HOOD 11–7251

1. Remove nuts (5). Move tube assembly (4) until it is free from the muffler. Remove nut and bolt (3). Loosen bolt (1). Remove muffler (2).



2. Loosen bolt (9). Remove precleaner hood (6).

3. Remove bolts (8). Fasten a hoist to the hood. Remove hood (7). Weight of the hood is 92 lb. (42 kg).



INSTALL HOOD 12–7251

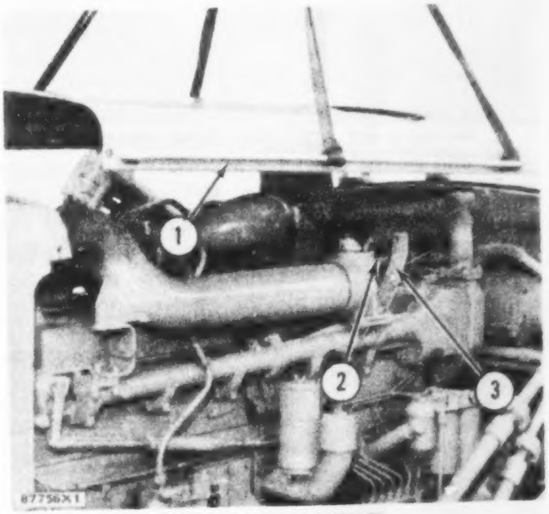
1. Fasten a hoist to the hood. Put hood (1) in position on the tractor. Remove the hoist.

2. Install the bolts that hold the hood to the dash. Connect the two hood clamps.

3. Install the precleaner hood on the precleaner. Tighten the bolt that holds the precleaner hood in position.

4. Put the muffler on the exhaust elbow. Put tube assembly (2) in position on the bottom of the muffler. Install the nuts that hold the tube assembly in position.

5. Install the bolt and nut that hold bracket (3) to the muffler.

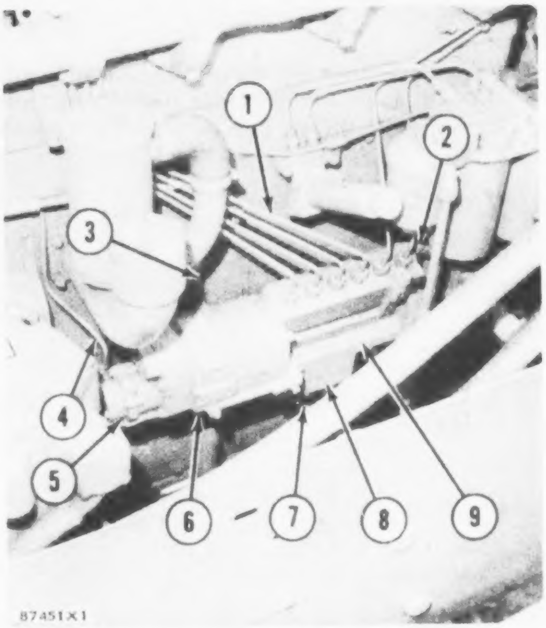


TYPICAL EXAMPLE

FUEL INJECTION PUMP HOUSING AND GOVERNOR

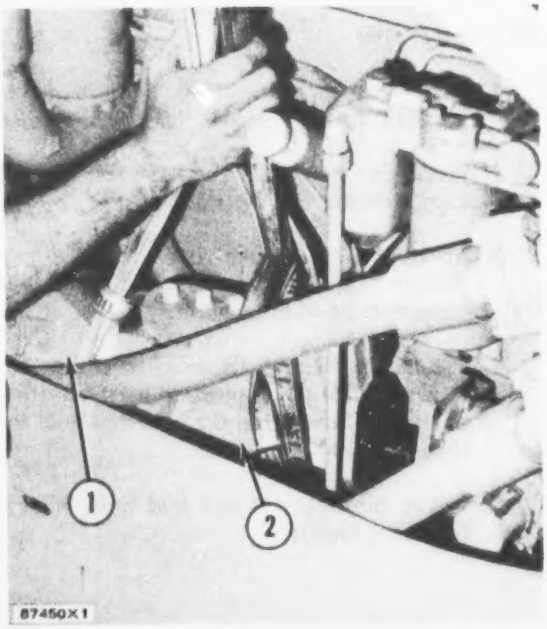
REMOVE FUEL INJECTION PUMP HOUSING AND GOVERNOR AS A UNIT 11–1286

1. Disconnect pressure tube (4) from the fuel ratio control (5).
2. Disconnect the fuel drain tube (7) from the bottom of the fuel injection pump housing (9).
3. Disconnect six fuel injection lines (1) from the fuel injection pumps. Put caps on all the fuel injection pumps. Put plugs in all the fuel injection lines.
4. Disconnect control linkage (3) from the control lever for the governor.
5. Remove bolts (2) that hold fuel supply tube to the pump housing.
6. Fasten a hoist to the pump housing and governor (6). Remove the bolts that hold the pump housing to the housing for accessory drive. Remove the bolts that hold bracket (8) to the cylinder block. Remove the fuel injection pump housing and governor as a unit. Weight is 50 lb. (23 kg).



INSTALL FUEL INJECTION PUMP HOUSING AND GOVERNOR AS A UNIT 12–1286

1. Put the fuel injection pump housing (2) and governor (1) as a unit in position on the housing for accessory drive. Make sure the end of the shaft for accessory drive engages in the groove (slot) in the camshaft for fuel injection. Install the bolts that hold the pump housing to the housing for accessory drive. Install the bolts that hold the bracket to the cylinder block.
2. Connect the six lines for fuel injection to their respective fuel injection pumps.
3. Connect the control linkage to the control lever for the governor.
4. Connect the fuel drain line to the bottom of the pump housing.
5. Connect the pressure tube to the fuel ratio control.

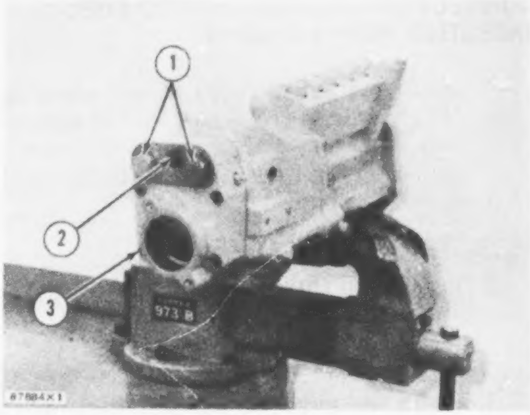


FUEL INJECTION PUMP HOUSING AND GOVERNOR

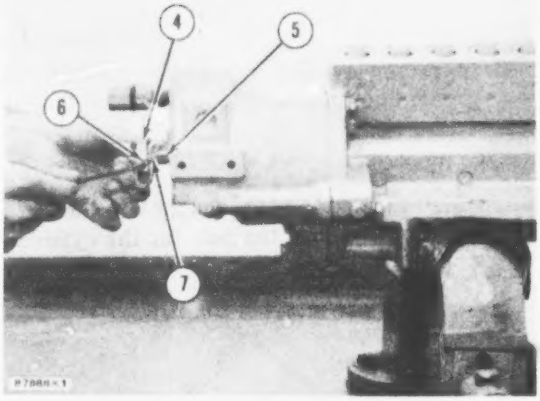
SEPARATION OF GOVERNOR FROM FUEL INJECTION PUMP HOUSING

start by:
a) remove fuel injection pump housing and governor
b) remove fuel ratio control

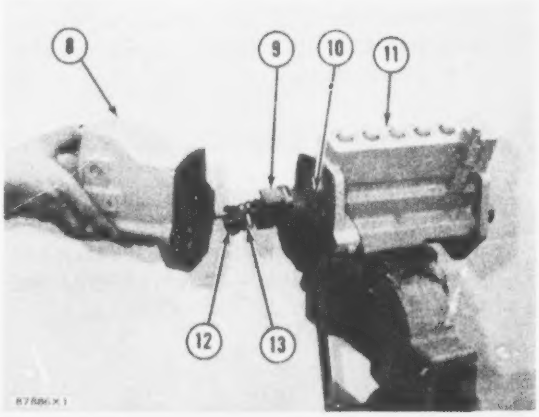
1. Remove the bolt and cover from the screws (1) for low and high idle adjustment.



2. Remove five bolts (2) and cover (3).
3. Loosen screw (6) that holds rack stop collar (4) to the bolt in the cylinder and weight assemblies.
4. Remove the rack stop collar, collar (7), and spring (5).



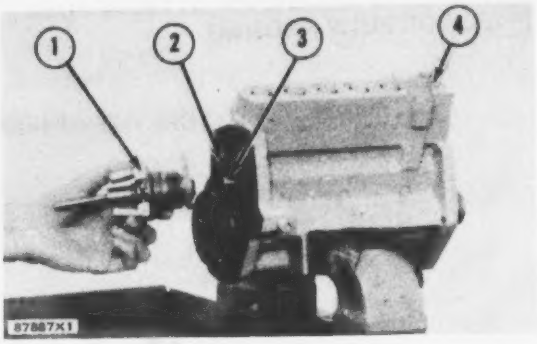
5. Remove the bolts that hold the governor (8) to the fuel injection pump housing (11). Remove the governor.
6. Remove the seat assembly (12) and spring (13).
7. Remove bolts (10) and a lock. Pull the cylinder and weight assemblies (9) clear of its dowels. Move the cylinder and weight assemblies to the side until the groove in the piston is free from the rack.



FUEL INJECTION PUMP HOUSING AND GOVERNOR

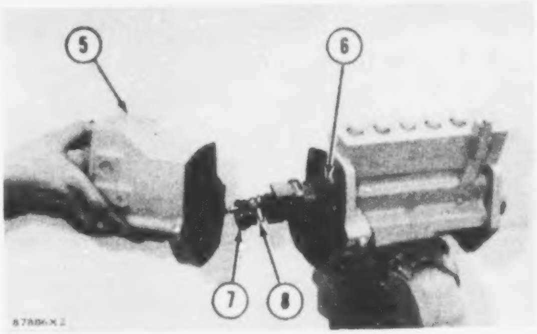
CONNECTION OF GOVERNOR TO FUEL INJECTION PUMP HOUSING

1. Install the cylinder and weight assemblies (1) over the dowels (2) on the fuel injection pump housing (4). Make sure the groove in the piston engages with the rack (3).



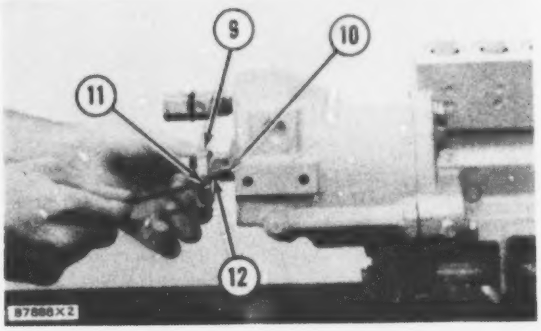
2. Install bolts (6) and a lock.

3. Install the spring (8) and seat assembly (7) over the cylinder and weight assemblies.



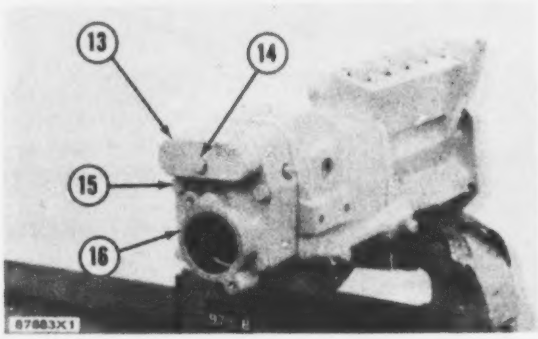
4. Put the governor (5) in position on the pump housing. Install the bolts that hold it.

5. Install the spring (10), collar (12), and rack stop collar (9) on the bolt for the cylinder and weight assemblies. Tighten the screw (11) that holds the rack stop collar on the bolt.



6. Install cover (16) and bolts (15) that hold it. Install cover (13) over the screws for low and high idle adjustment. Install the bolt (14) that holds it.

7. After the fuel injection pump housing and governor as a unit and fuel ratio control are installed, make adjustments to the rack and governor. See FUEL RACK SETTING and GOVERNOR ADJUSTMENTS in TESTING AND ADJUSTING.



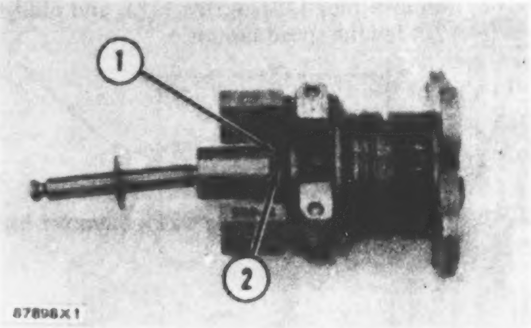
end by:
- a) install fuel ratio control
- b) install fuel injection pump housing and governor

GOVERNOR

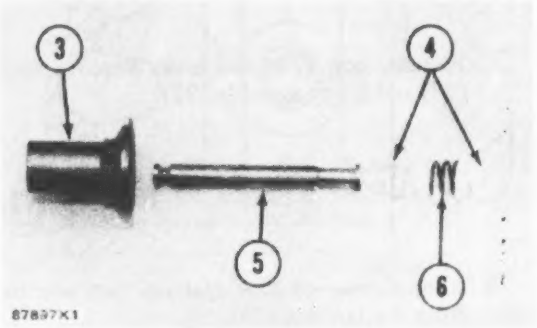
DISASSEMBLE GOVERNOR 15–1264

start by:
- a) separation of governor from fuel injection pump housing

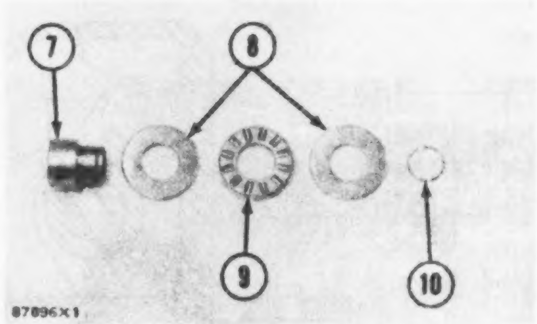
1. Remove ring (1) and dowel (2).



2. Remove seat (3), bolt (5), spring (6), and washers (4).

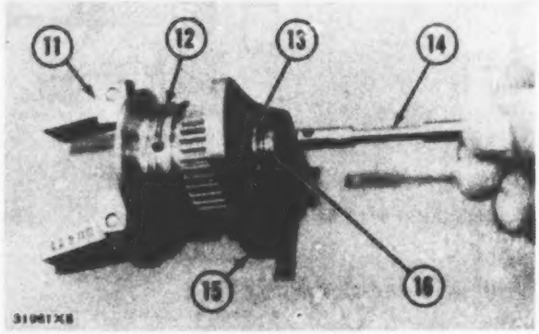

3
4
5
6
87897X1

3. Remove the sleeve and bearing as a unit. Remove ring (10), two races (8), and bearing (9) from sleeve (7).


7
8
9
10
87896X1

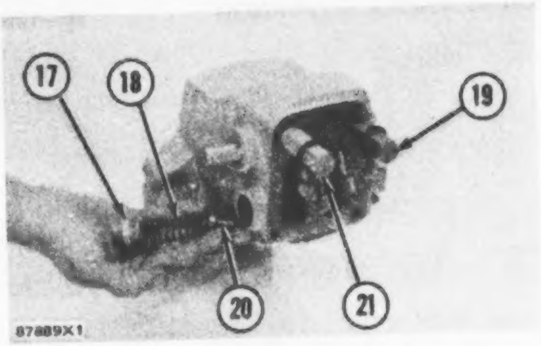
4. Remove valve (14).

5. Remove lock (12). Remove piston (16), sleeve (13), and cylinder (15) from weight assembly (11).


11
12
13
14
15
16
31961X8

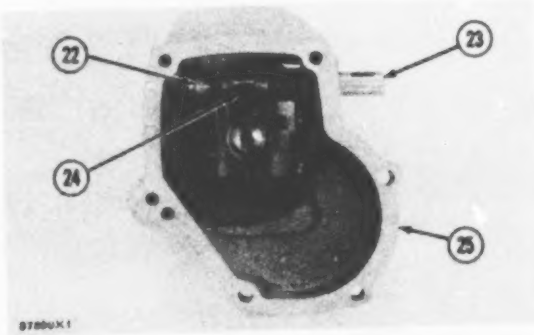
GOVERNOR

6. Remove plug (17), spring (18), and plunger (20) for the speed limiter.

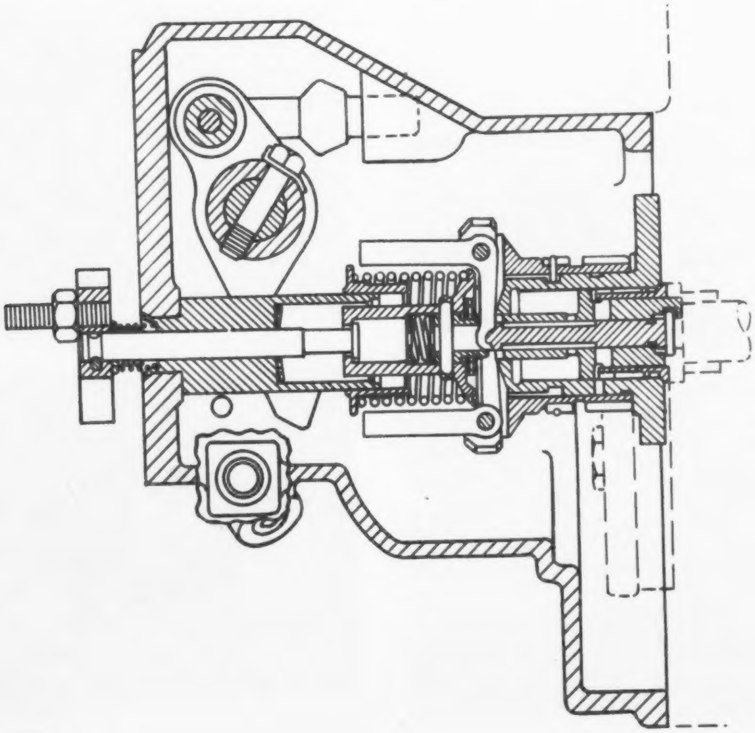

17
18
19
20
21
87889X1

7. Remove low idle screw (21). Remove high idle screw (19).

8. Remove bolt (24) and lock. Remove shaft (23) and lever assembly (22).


22
23
24
25
87890X1

9. Remove the lip type seal and two bearings from the housing (25).



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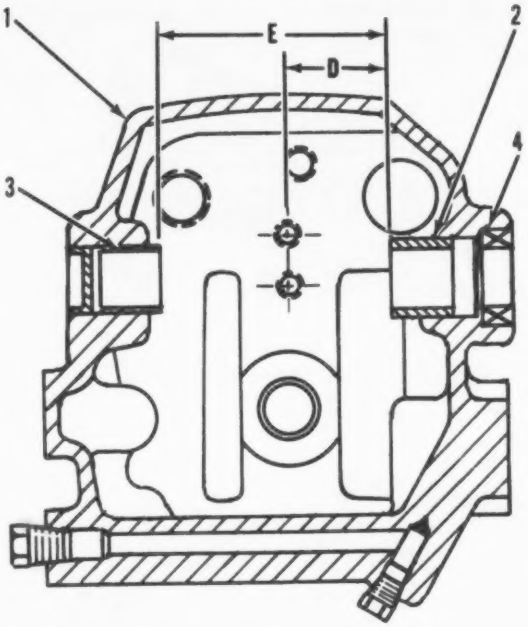
GOVERNOR

ASSEMBLE GOVERNOR 16–1264

Tools Needed		A	B	C
1P529	Handle	1	1	1
1P460	Drive Plate	1		
1P456	Drive Plate	1	1	
1P458	Drive Plate		1	
1P467	Drive Plate			1
1P457	Drive Plate			1

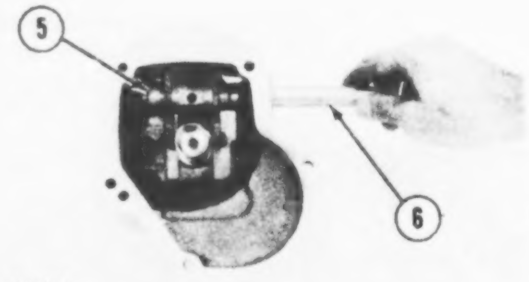
1. Install bearing (2) in housing (1) with tooling (A). Make sure dimension (D) is 1.073 in. (27.25 mm).



92461X1

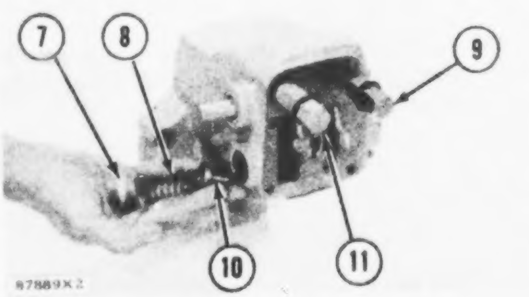
2. Install bearing (3) in the housing with tooling (B). Make sure dimension (E) is 2.385 ± .005 in. (60.58 ± 0.13 mm).

3. Install lip type seal (4) in the housing with tooling (C). Make sure the rubber lip of the seal is toward the outside of the housing. Put a light amount of oil on the rubber lip of the seal.



87893X1

4. Put lever assembly (5) in position in the housing. Slide the shaft (6) through the seal and lever assembly. Install the bolt and lock that hold the shaft in position in the lever assembly.



87889X2

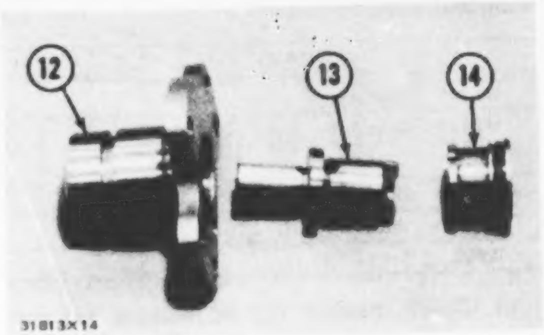
5. Install plunger (10), spring (8), and plug (7) for the speed limiter.

6. Install low idle screw (11). Install high idle screw (9).

GOVERNOR

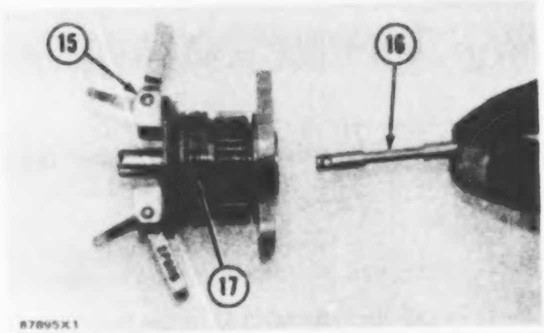
7. Install piston (13) and sleeve (14) in cylinder (12).

8. Install the cylinder in weight assembly (15). Install ring (17) that holds it.



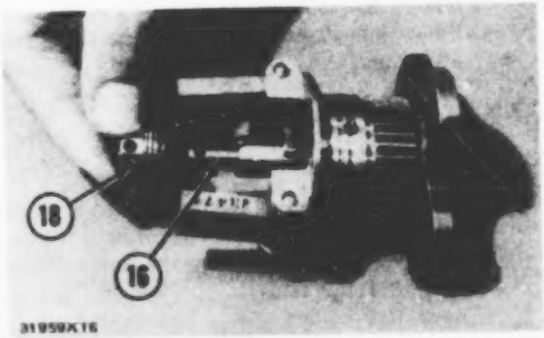
9. Install valve (16) in piston (13).

10. Install a race, bearing, and race, in that order, on sleeve (18). Install the ring on the sleeve.

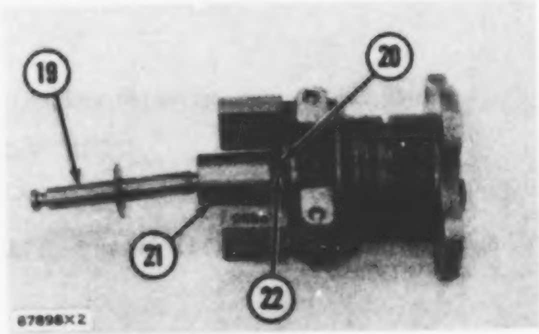


11. Install the sleeve on valve (16). Make sure the holes in the valve and sleeve are in alignment.

12. Install bolt (19), a washer, spring, and washer, in that order, in seat (21).



13. Put the hole in the seat in alignment with the holes in the sleeve and valve. Install dowel (22) and lock (20).



end by:
  a) connection of governor to fuel injection pump housing

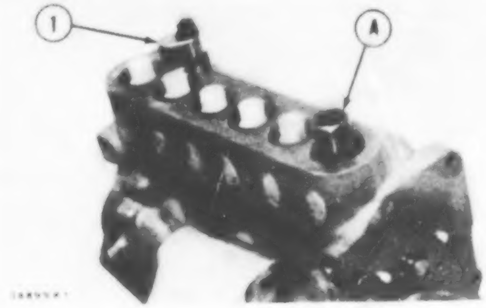
FUEL INJECTION PUMP HOUSING

DISASSEMBLE FUEL INJECTION PUMP HOUSING 15–1253

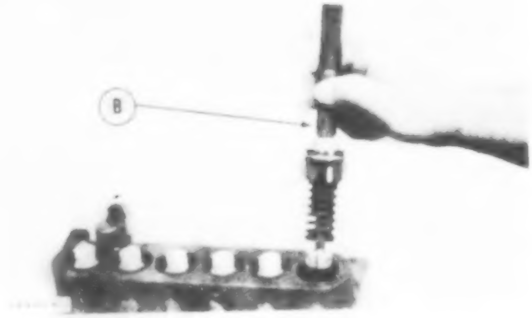
Tools Needed		A	B	C
8S4613	Wrench	1		
8S2244	Extractor		1	
8S2241	Camshaft Bearing Installation & Removal Tool Group			1

start by:

a) separation of governor from fuel injection pump housing

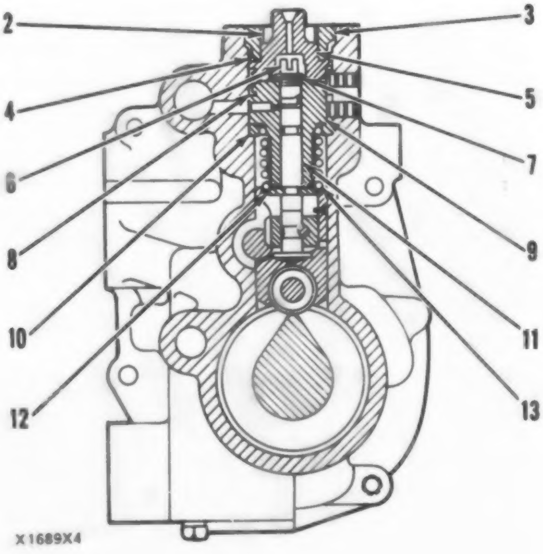


1. Remove the cover (1) for the rack centering pin. Move the rack until the centering pin can be pushed down. Install the cover so the edge of the cover holds the pin down.
2. Remove the protection cap and felt washer (2).
3. Install wrench (A) and remove bushing (3).
4. Remove seal (4).
5. Install extractor (B). Hold the rack toward the driven end of the pump housing and remove the fuel injection pump.



CAUTION: Do not remove fuel injection pumps without the rack centering pin installed and the rack held toward the driven end of the pump housing.

6. Remove spacer (10). Put identification on spacers (10), fuel injection pumps, and lifters (14) as to their respective location in the pump housing. These parts must be installed back in their original positions in the pump housing.
7. Disassemble injection pumps using the following method:
   a) Remove bonnet (5), ring (8), spring (7), and check valve (6) from barrel (9).
   b) Remove plunger assembly (11), washer (12), and spring (13) from barrel (9).

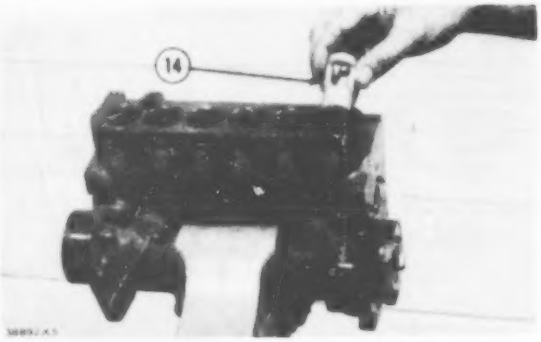


CAUTION: During disassembly and assembly of fuel injection pumps, use much care to prevent damage to the surfaces of plunger assemblies. The barrel and plunger assemblies have a special fit with each other, and are not to be used with other barrels or plunger assemblies.

FUEL INJECTION PUMP HOUSING

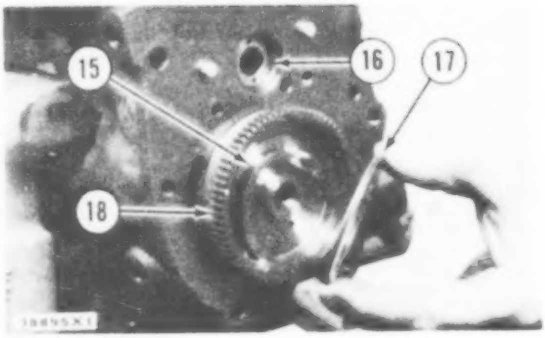
8. Remove the cover for the rack centering pin. Remove the spring and pin.

9. Remove the rack from the pump housing.



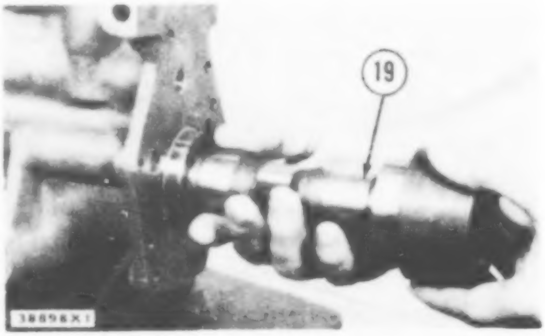
10. Remove lifters (14). Put identification on lifters so they can be installed back into their original positions in housing.

11. Remove the bolt, lock and plate (17).



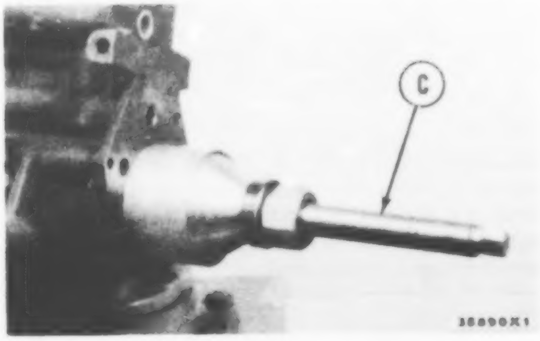
12. Remove spring (15) and gear assembly (18) from the camshaft.

13. Remove the camshaft (19) from the pump housing.



14. Install tool group (C) and remove the camshaft bearings from the pump housing.

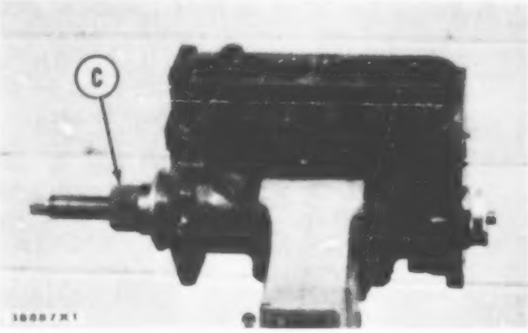
15. Remove the two rack bearings (16) from the pump housing.



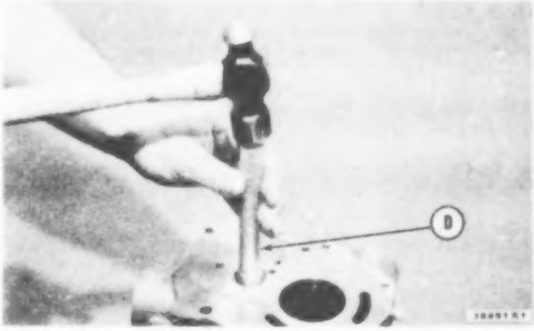
FUEL INJECTION PUMP HOUSING

ASSEMBLE FUEL INJECTION PUMP HOUSING 16–1253

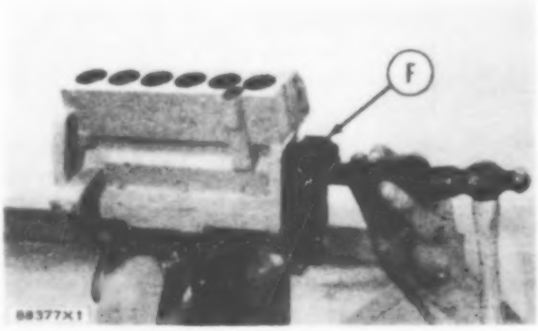
Tools Needed		A	B	C	D	E	F
8S4613	Wrench	1					
8S2244	Extractor		1				
8S2241	Camshaft Bearing Installation & Removal Tool Group			1			
1P529	Handle				1		
1P460	Drive Plate				1		
1P455	Drive Plate				1		
9S240	Rack Setting Group					1	
9S6326	Rack Bearing Installation Tool Group						1



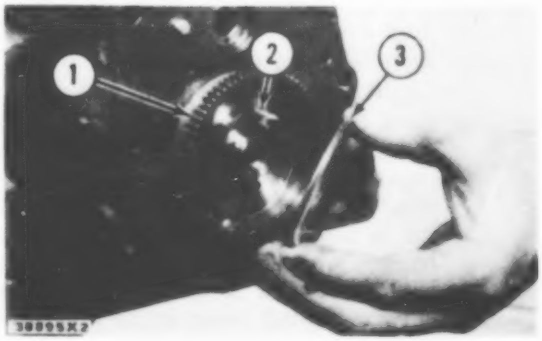
1. Install camshaft bearings in pump housing with tool group (C). Install the bearing at governor end of pump housing so the oil hole in bearing is in alignment with oil hole in pump housing. Install the two bearings on each end of housing so the edge of bearing will be even with end of pump housing.



2. Install the rack bearing in the governor end of the pump housing with tooling (D). Make sure the face of the bearing is .195 ± .005 in. (4.95 ± 0.13 mm) inside the face of the pump housing.



3. Install the rack bearing at the opposite end of the pump housing with tool group (F).

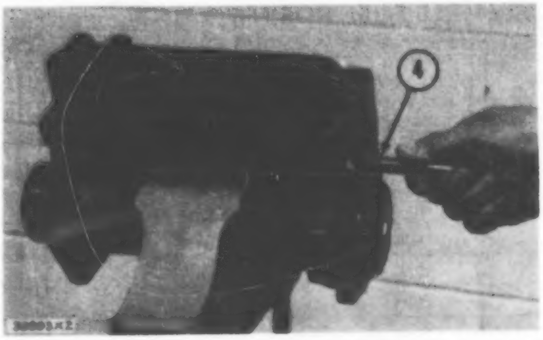


4. Put clean engine oil on the camshaft. Install it in the pump housing.

5. Put the governor drive gear (1) and spring (2) in position on the camshaft. Install the camshaft plate (3), bolt, and lock.

FUEL INJECTION PUMP HOUSING

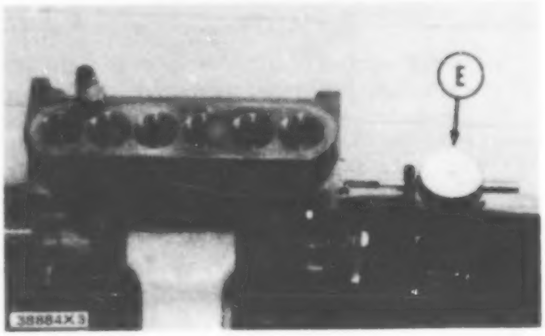
6. Install the lifters in their respective positions in pump housing. Put clean oil all over the rack (4) and install it in the pump housing. The (slot) groove in rack must be toward the governor end of pump housing.



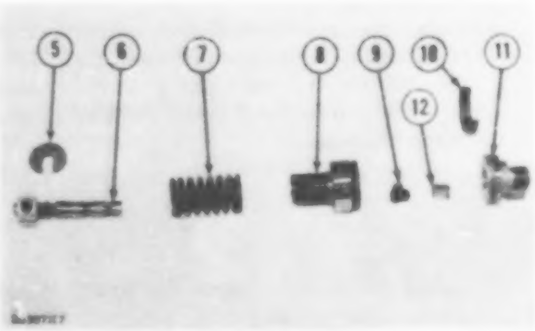
7. Install the spring, rack centering pin, and cover. Push the pin down and put the edge of the cover over the end of pin to hold the pin down.

8. Install the spacers in their respective positions in housing. If new lifters and pumps are to be installed, an adjustment must be made to the fuel pump timing dimension. See MAKING A CHANGE TO THE TIMING DIMENSION FOR THE FUEL INJECTION PUMP: OFF ENGINE in TESTING AND ADJUSTING SECTION.

9. Install the dial indicator, from tool group (E) on the pump housing as shown. Hold rack toward driven end of pump housing, and move dial indicator to the "ZERO" position.

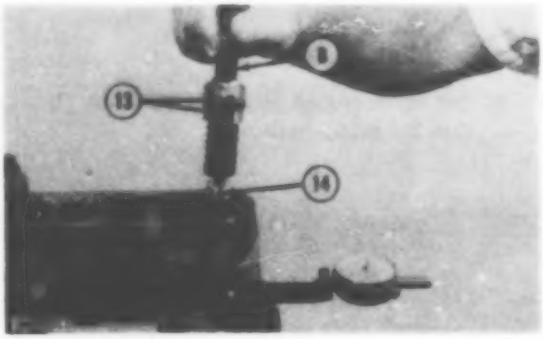


10. Assemble the injection pumps as follows:
    a) Put clean fuel oil on all parts of the fuel injection pumps.
    b) Install the spring (7), washer (5), and plunger assembly (6) into the barrel (8).
    c) Install the spring (12), check valve (9), bonnet (11), and ring (10) on the barrel.



CAUTION: Do not install fuel injection pumps in pump housing until rack has been moved to center position. Rack is in center position when centering pin is held down and rack held toward the driven end of pump housing.

11. With the rack in center position, install the fuel injection pumps as follows:
    a) Turn camshaft until lobe of camshaft is down for pump being installed.
    b) Install tool (B) on the pump.
    c) Look down pump and put notches (13) in bonnet and barrel in alignment with (slot) groove (14) in pump gear. The slot (14) will be in alignment with center of the notches (13). Put pump in pump housing with notches (13) in alignment with guide pins in bore of the pump housing. Install pump in its respective position in the pump housing.



FUEL INJECTION PUMP HOUSING

d) Install the seal and bushing (15). Push down on tool (B), and tighten the bushing by hand (finger tight only) until the bushing is even with top surface of housing. If bushing can not be installed this far by hand, remove it. Remove pump. Put parts in alignment and install pump again.

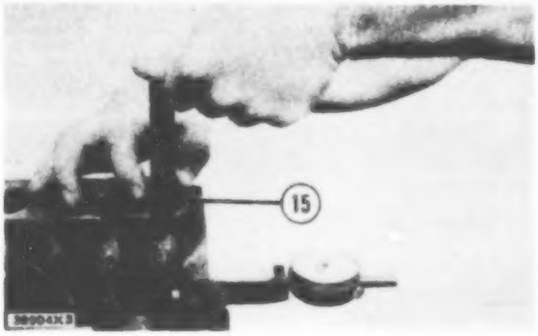
CAUTION: Do not tighten bushing even with face of housing by using a wrench. If pump has been installed correctly, the bushing can be tightened with the fingers until it is even with the face of the pump housing.

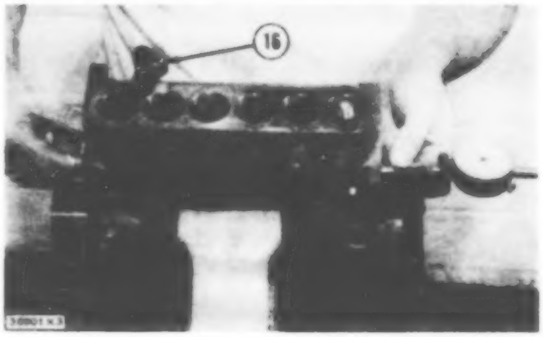
e) Install tool (A) and tighten bushing to a torque of 50 ± 10 lb.ft. (6.9 ± 1.4 mkg).

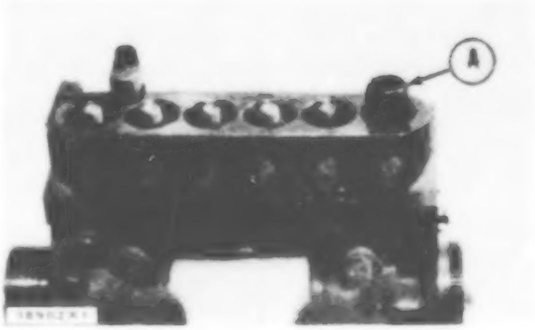
f) After each pump is installed, check the rack travel as follows. Move cover (16) off centering pin and let pin come up. Move the rack in both directions and read the measurement of the dial indicator. If pump is installed correctly, total rack travel will be approximately .800 in. (20.3 mm). If pump has been installed one tooth off, the total rack travel will be decreased to about .600 in. (15.2 mm). If total rack travel can not be made, remove the pump. Put components in alignment and install pump again.

g) Install tool (A) and tighten bushing to a torque of 150 ± 10 lb.ft. (20.7 ± 1.4 mkg). Install felt washers and protection caps.

h) Do steps (a) through (g) again for the other pumps.







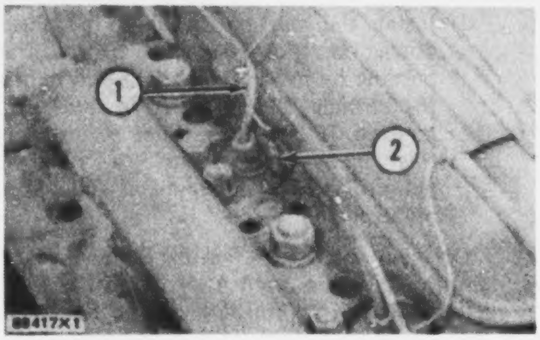
end by:

a) connection of governor to fuel injection pump housing

b) make adjustments to rack and governor (See FUEL RACK SETTING and GOVERNOR ADJUSTMENTS in TESTING AND ADJUSTING SECTION)

GLOW PLUGS, ACCESSORY DRIVE

REMOVE GLOW PLUGS 11–1412



1. Disconnect wire (1) from the glow plug.

2. Remove glow plug (2) from the precombustion chamber.

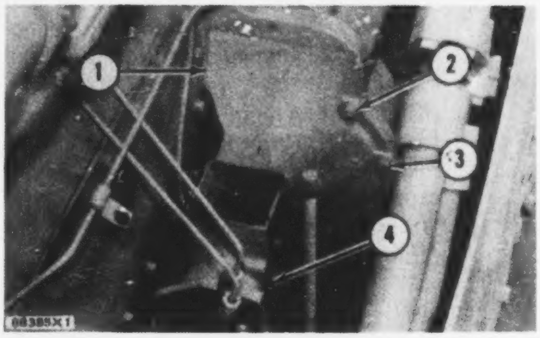
INSTALL GLOW PLUGS 12–1412

1. Put 9M3710 Anti-Seize Compound on the threads of the glow plug.

2. Install the glow plug in its precombustion chamber. Tighten the glow plug to a torque of 108 ± 12 lb.in. (124.5 ± 13.8 cm.kg).

3. Connect the wire to its repective glow plug.

REMOVE ACCESSORY DRIVE 11–1207

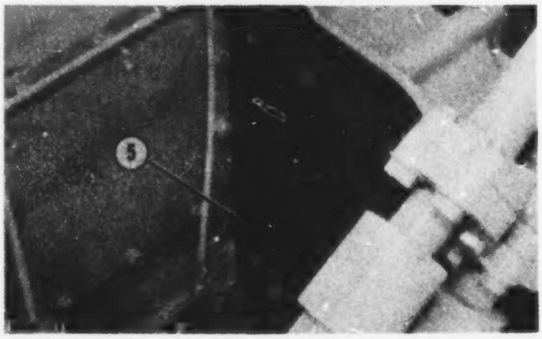


start by:
  - a) remove fuel transfer pump
  - b) remove fuel filter base
  - c) remove fuel injection pump housing and governor

1. Disconnect bleed tube (4) from the accessory drive.

2. Fasten a hoist to the accessory drive.

3. Remove bolts (3) and nuts (2) that hold the accessory drive to the front timing gear cover.



4. Remove the accessory drive (1). Weight is 56 lb. (25 kg).

5. Inspect ferrule (5) for damage. Remove it if necessary.

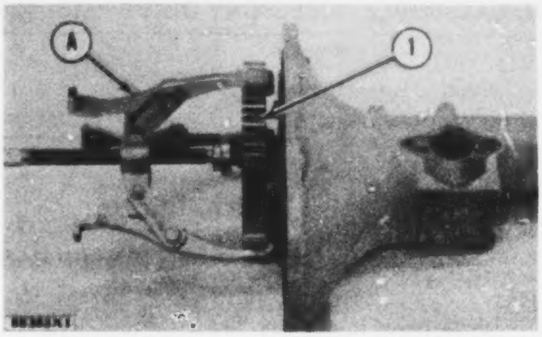
ACCESSORY DRIVE

INSTALL ACCESSORY DRIVE 12–1207

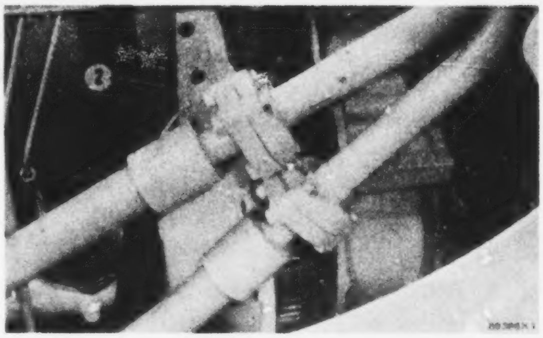
Tools Needed		A	B
1P2321	Puller Assembly	1	
8B7560	Step Plate	1	
5P4240	Timing Plate		1

1. Install a new ferrule in the cylinder block if necessary.

2. Loosen the nut on the accessory drive shaft. Loosen timing gear (1) from the shaft taper with tooling (A).

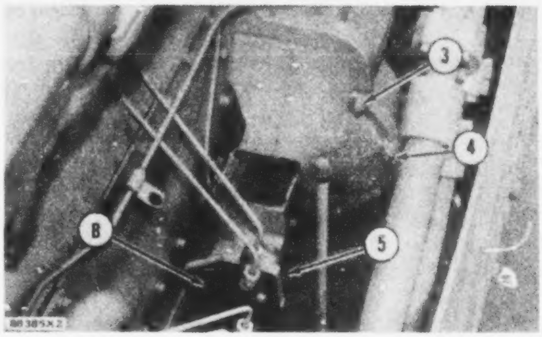


3. Fasten a hoist to the accessory drive (2) and put it in position on the front timing gear housing. Install the nuts (3) and bolts (4) that hold it. Make sure the teeth of timing gear (1) engage the teeth of the camshaft gear.



4. Turn the crankshaft until No. 1 piston is at top center on the compression stroke. See FINDING TOP CENTER COMPRESSION POSITION FOR NO. 1 PISTON in TESTING AND ADJUSTING SECTION.

5. Install tool (B) on the rear of the accessory drive. Turn the accessory drive shaft until the chamfered end (tang) of the accessory drive shaft engages in the groove of tool (B).



6. Remove the cover from the front of the front timing gear housing. Tighten the nut on the accessory drive shaft to a torque of 125 ± 10 lb.ft. (17.3 ± 1.4 mkg). Install the cover on the front of the front timing gear cover.

7. Remove tool (B).

8. Connect the bleed tube (5) to the bottom of the accessory drive.

end by:
- a) install fuel injection pump housing and governor
- b) install fuel filter base
- c) install fuel transfer pump

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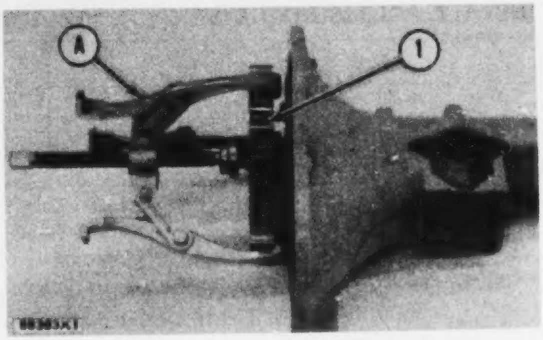
ACCESSORY DRIVE

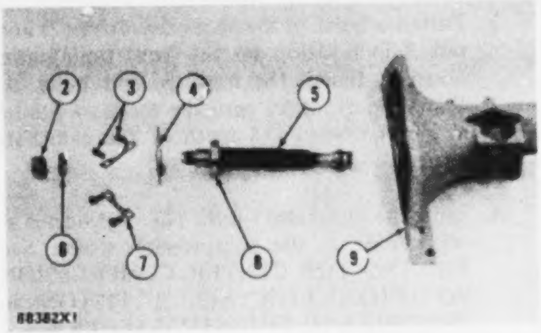
DISASSEMBLE ACCESSORY DRIVE 15–1207

	Tools Needed	A
1P2321	Puller Assembly	1
8B7560	Step Plate	1

start by:
a) remove accessory drive



1. Remove the nut and washer from the shaft.
2. Remove timing gear (1) with tooling (A).
3. Remove sleeve (2) and spacer (6) from the shaft.
4. Remove bolts (3), locks (7), and retainer (4).
5. Remove shaft (5) from housing (9).
6. Remove bearing (8) from shaft with tooling (A).

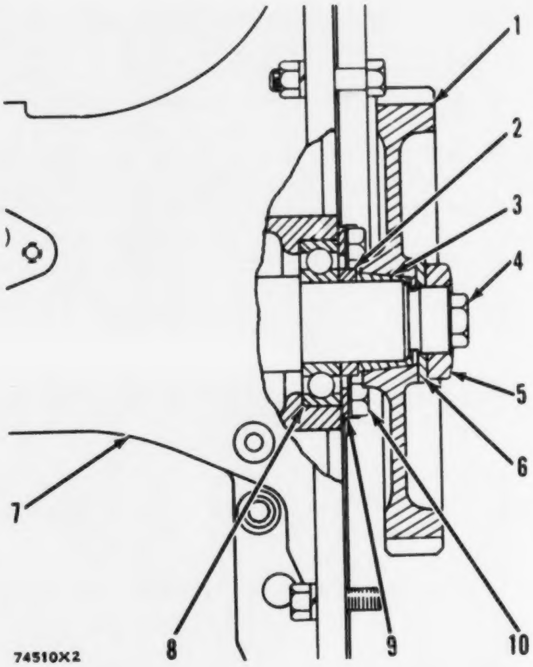


ASSEMBLE ACCESSORY DRIVE 16–1207

1. Heat bearing (8) in oil to a maximum temperature of 275°F (135°C). Install the bearing on shaft (4).
2. Install the shaft in housing (7).
3. Install retainer (9), locks and bolts (10).
4. Install spacer (2) and sleeve (3) on the shaft.
5. Install gear (1) on the shaft. Install washer (6) on the shaft with the larger inside diameter toward the gear.
6. Install nut (5) on the shaft (finger tight only).

NOTE: Nut (5) will be tightened to its correct torque at installation. See INSTALL ACCESSORY DRIVE.

end by:
a) install accessory drive

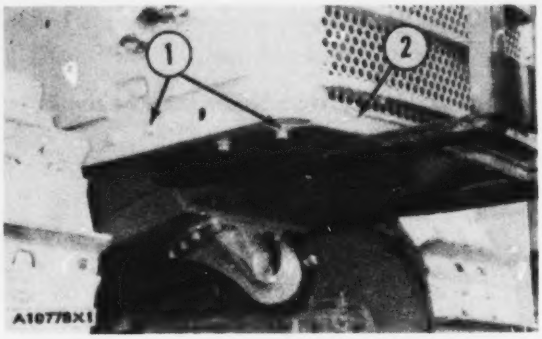


CRANKCASE GUARDS (FRONT)

REMOVE CRANKCASE GUARDS (FRONT) 11–7151

1. Put a lift truck in position under crankcase guard (2) as shown.

2. Remove the eight bolts (1) that hold the crankcase guard in position. Remove the crankcase guard. Weight of crankcase guard (1) is 225 lb. (102 kg).

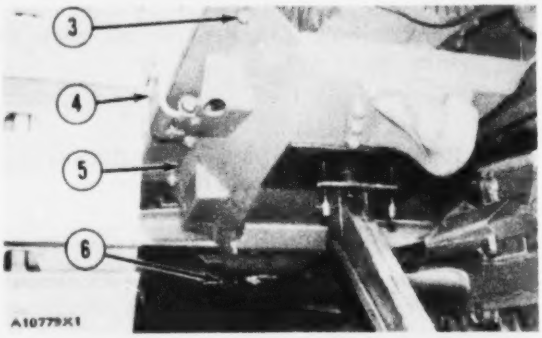


3. Remove two bolts (6) from the rear bracket of crankcase guard (5).

4. Put two floor jacks in position under the crankcase guard as shown.

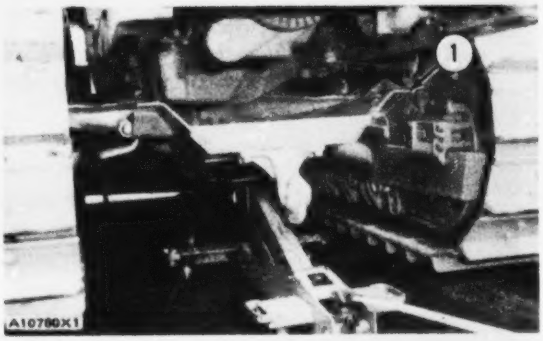
5. Remove six nuts (3) and washers. Remove two bolts (4) and nuts from the hinge.

6. Lower the crankcase guard down until it is clear of the tractor. Weight of crankcase guard (5) is 730 lb. (331 kg).



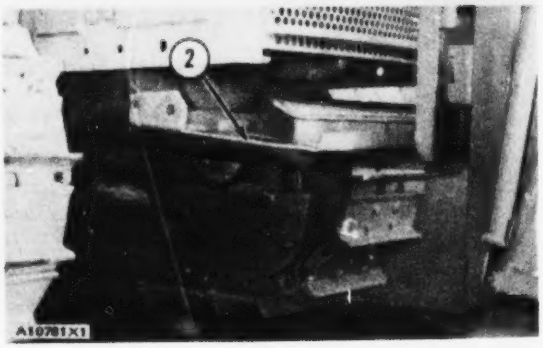
INSTALL CRANKCASE GUARDS (FRONT) 12–7151

1. Put crankcase guard (1) on two floor jacks. Lift the crankcase guard until it makes contact with the frame. Make sure the bolt holes are in alignment with the brackets for the bolts that hold the crankcase guard in position.



2. Install the six bolts, washers and nuts that hold the crankcase guard to the frame. Install the two bolts and nuts that hold the hinge to the frame.

3. Put crankcase guard (2) in position on the forks of a lift truck. Lift the crankcase guard until it is in position under the radiator. Install the eight bolts that hold the crankcase guard in position.

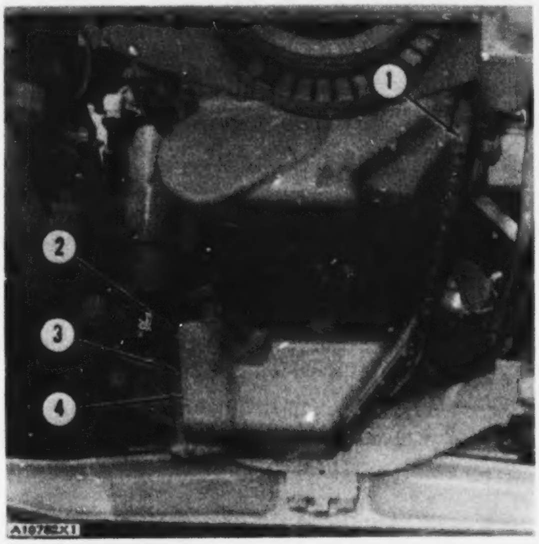


OIL PAN

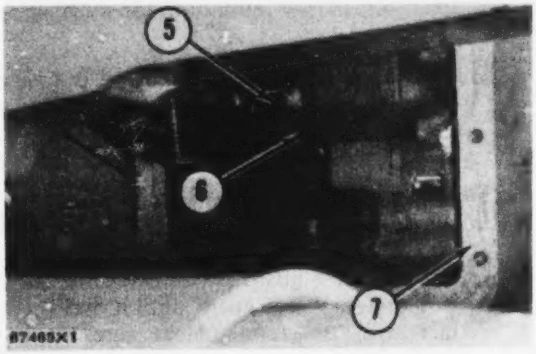
REMOVE OIL PAN 11–1302

start by:
 a) remove crankcase guards (front)

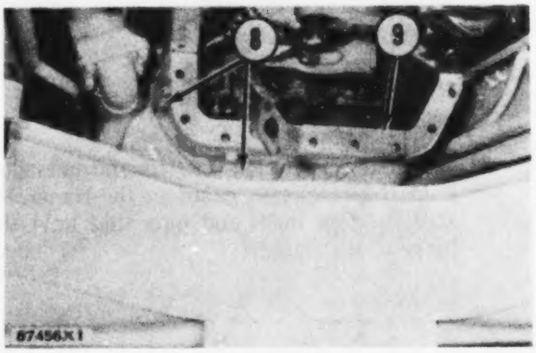
1. Drain the oil from the oil pan.
2. Remove guide tube (2) for the oil level gauge from the side cover.
3. Remove bolts (3). Remove side cover (4) from the oil pan.



4. Remove bolts (6) and locks. Remove rear oil sump tube (5) from the oil pump.
5. Put floor jacks under the oil pan. Remove bolts (1) that hold the front section of the oil pan to the cylinder block.
6. Remove the front section (7) of the oil pan. Weight of the front section of the oil pan is 300 lb. (136 kg).



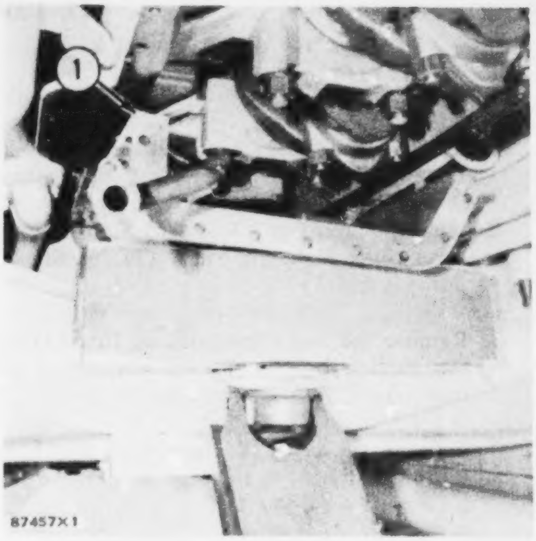
7. Put blocks under the rear section of the oil pan. Remove bolts (8) that hold the rear section of the oil pan to the cylinder block.
8. Put a floor jack next to the equalizer bar. Slide the oil pan forward on the floor jack.
9. Remove the rear section of the oil pan (9). Weight of the rear section of the oil pan is 50 lb. (23 kg).



OIL PAN

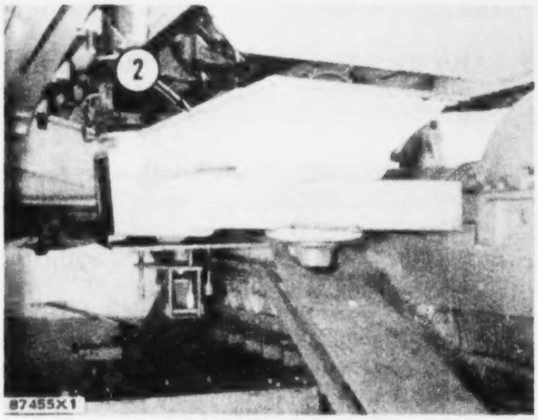
INSTALL OIL PAN 12–1302

1. Put the rear section (1) of the oil pan in position on the cylinder block and the flywheel housing with a floor jack. Install the bolts that hold it.



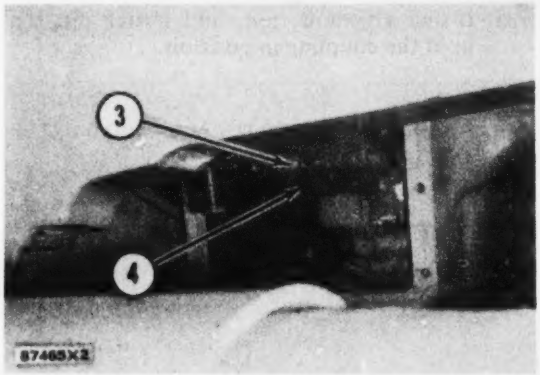
2. Put the front section (2) of the oil pan in position on the cylinder block with a floor jack. Install the bolts that hold it.

3. Put rear oil sump tube (3) in position on the oil pump. Install bolts (4) and locks that hold it.



4. Put the right side cover in position on the oil pan. Install the bolts that hold it.

5. Install the guide tube for oil level gauge on the side cover.



6. Fill the engine with oil to the correct level.

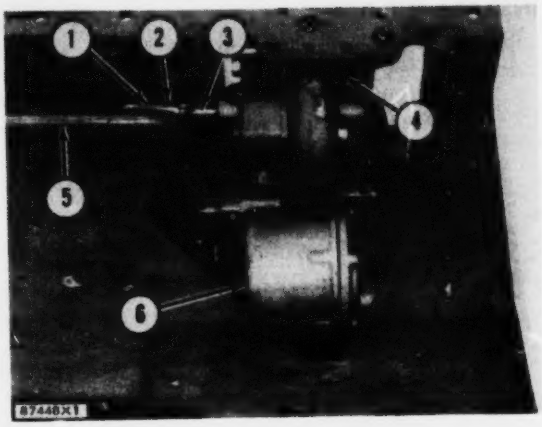
end by:
a) install crankcase guards

OIL PUMP

REMOVE OIL PUMP 11–1304

start by:
a) remove oil pan (front section only)

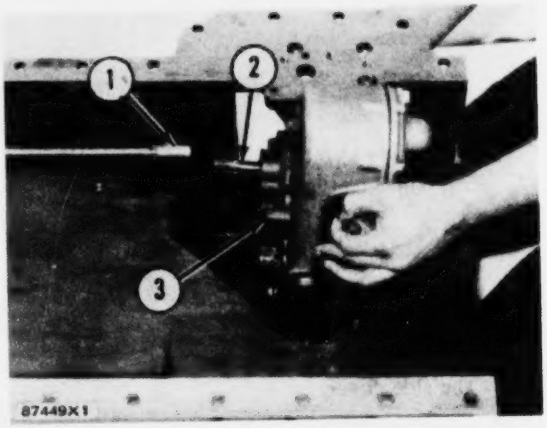
1. Remove the cotter pin, nut, and bolt (2) that hold the splined coupling in position.
2. Slide the coupling (1) toward the oil pump drive until the drive shaft (3) for the oil pump is free.
3. Remove the bolts that hold the tube (5) for the suction bell to the oil pump and oil pump drive. Remove the tube.
4. Remove the bolts (4) and locks that hold the oil pump (6) to the oil pan. Remove the oil pump.



INSTALL OIL PUMP 12–1304

1. Put the tube for the suction bell in position on the oil pump. Install the bolts that hold it.
2. Put the oil pump (3) in position on the oil pan. Install the bolts and locks that hold it.
3. Install the bolts that hold the tube for the suction bell to the oil pump drive.
4. Slide the splined coupling (1) on the drive shaft (2) for the oil pump so it connects the drive shafts for the oil pump and oil pump drive.
5. Install the bolt, nut, and cotter pin that hold the coupling in position.

end by:
a) install oil pan (front section only)

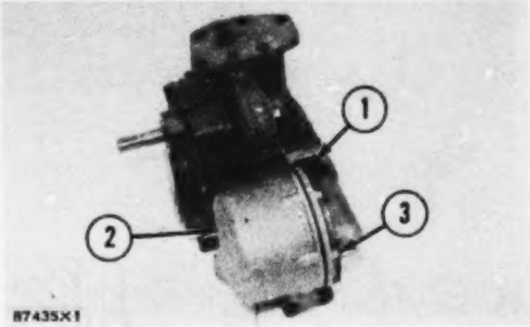


OIL PUMP

DISASSEMBLE OIL PUMP 15–1304

start by:
  a) remove oil pump

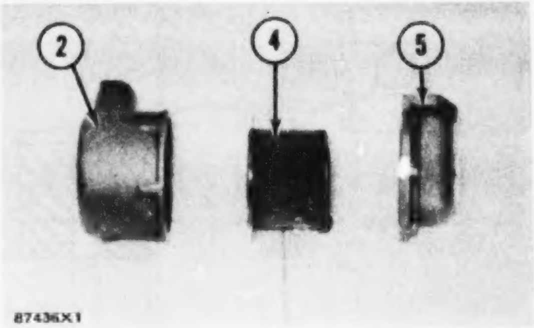
1. Remove bolts (1) and bell (2) from the oil pump. Remove bolts (3) that hold the cover to the bell.



87435X1

2. Remove cover (5) and screen (4) from bell (2). Clean the screen.

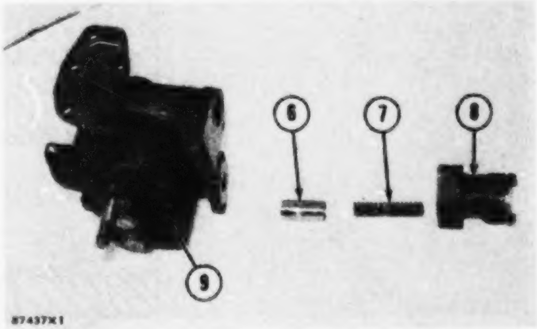
3. Remove the bolts that hold the relief valve to the pump body. Remove relief valve body (8), spring (7), and plunger (6).



87436X1

4. Remove bolts (9) that hold the oil pump together.

5. Remove main pump body (10) from scavenge pump body (11).



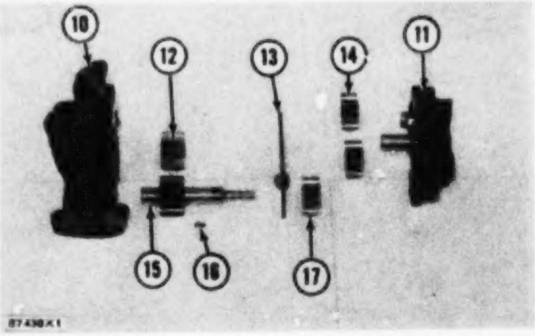
87437X1

6. Remove gear (12) and shaft assembly (15) from body (10).

7. Remove gear (17), key (16), and spacer (13) from the shaft assembly.

8. Remove two gears (14) from body (11).

9. Remove the bearings from gear (12) and two gears (14).



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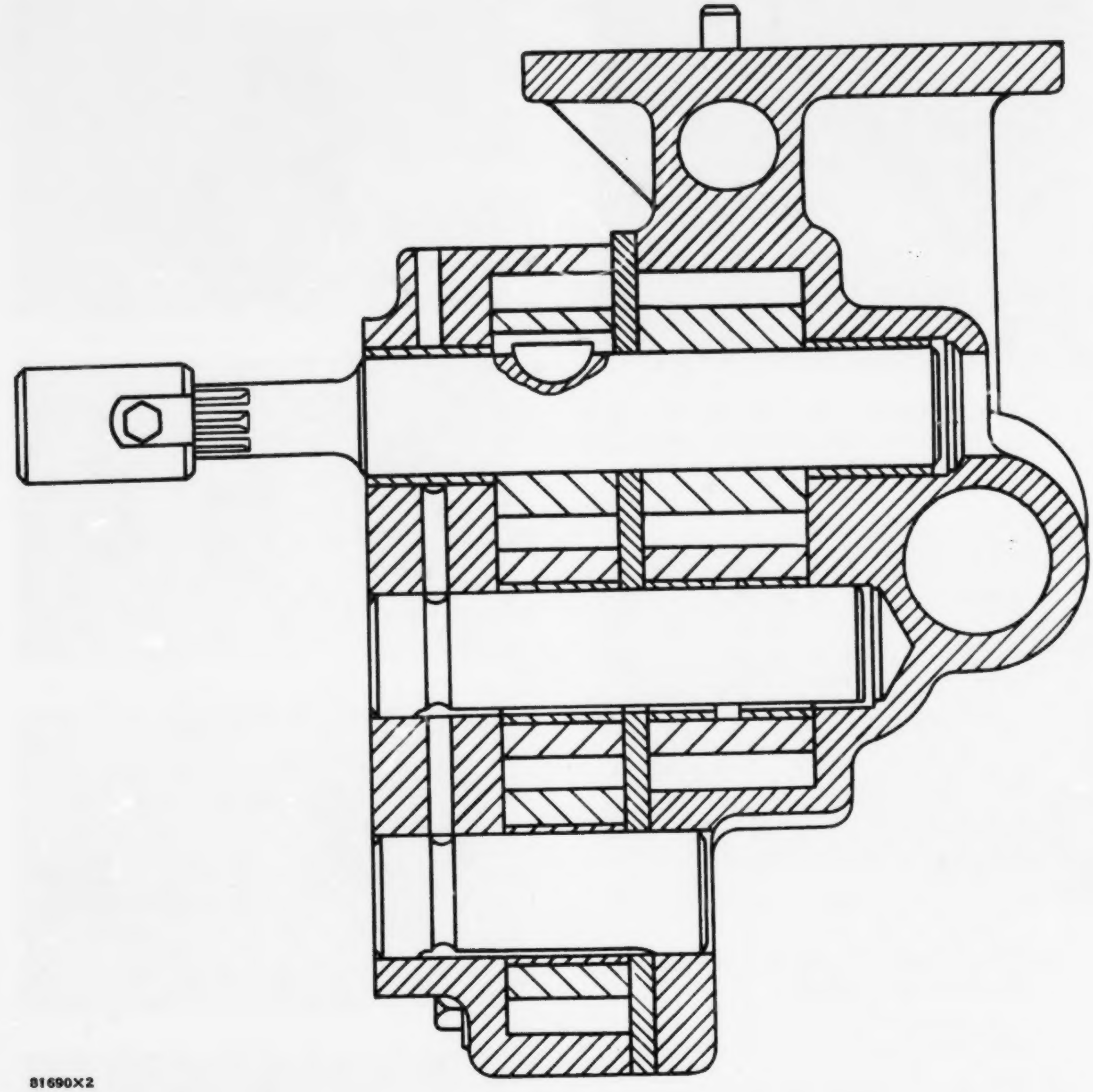
10. Remove the bearings from the two bodies.

OIL PUMP



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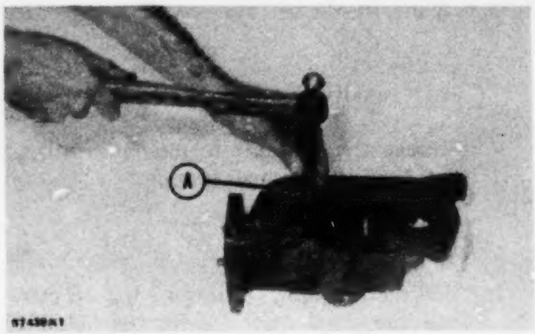
OIL PUMP

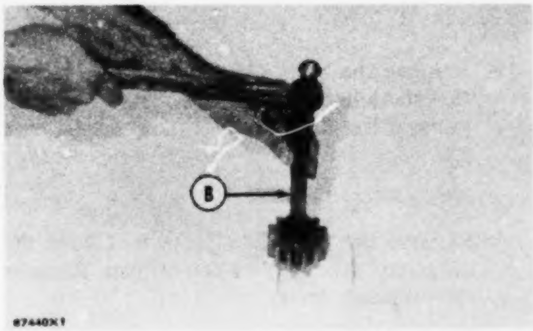
ASSEMBLE OIL PUMP 16–1304

Tools Needed		A	B
1P529	Handle	1	1
1P466	Drive Plate	1	1
1P468	Drive Plate	1	
1P469	Drive Plate		1

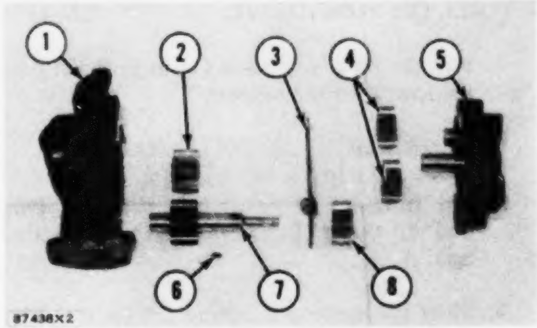
NOTE: Put a small amount of oil on all inner parts of the oil pump before assembly.



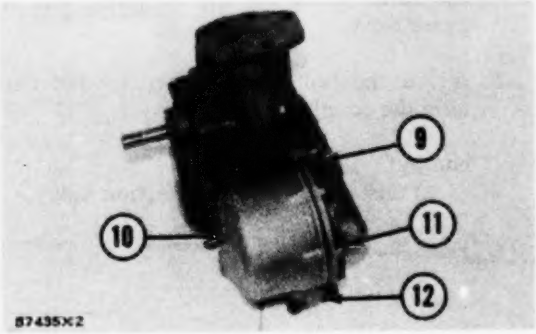
1. Install the bearings in the two bodies with tooling (A). Make sure the bearings are .030 ± .010 in. (0.76 ± 0.25 mm) below the inside surface of the bodies.



2. Install the bearings in gears (4) with tooling (B). Make sure the bearings are .030 ± .010 in. (0.76 ± 0.25 mm) below the surface of the gears.
3. Install the bearings in gear (2) with tooling (B). Make sure the bearings are .016 ± .010 in. (0.41 ± 0.25 mm) below each surface of the gear.
4. Install spacer (3), key (6) and gear (8) on shaft assembly (7).



5. Install gear (2) and shaft assembly (7) in body (1).
6. Install two gears (4) in body (5).
7. Put body (5) in position on body (1). Install the bolts that hold the bodies together.
8. Install the spring and the plunger in the relief valve body. Install the relief valve (12) on the oil pump.



9. Put the screen in position in bell (10). Install the cover and bolts (11) that hold it on the bell.
10. Install the bell and bolts (9) that hold it on the oil pump.

NOTE: Pump must turn freely by hand after assembly.

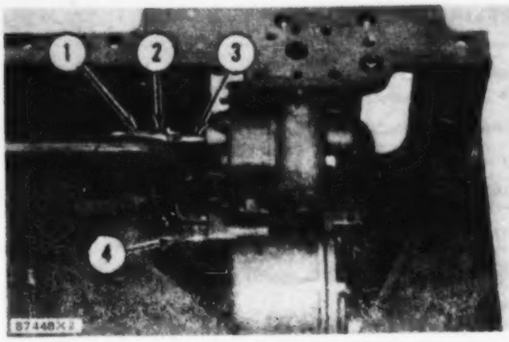
end by:
a) install oil pump

OIL PUMP DRIVE

REMOVE OIL PUMP DRIVE 11–1313

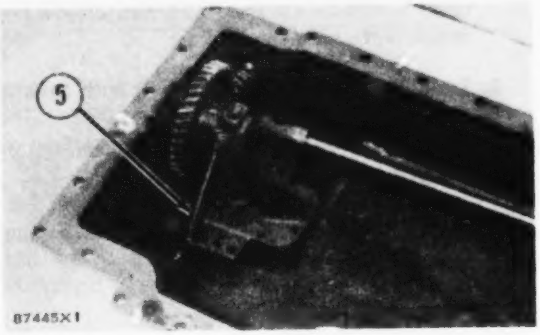
start by:
a) remove oil pan (front section only)

1. Remove the cotter pin, nut, and bolt (2) that hold the splined coupling in position.



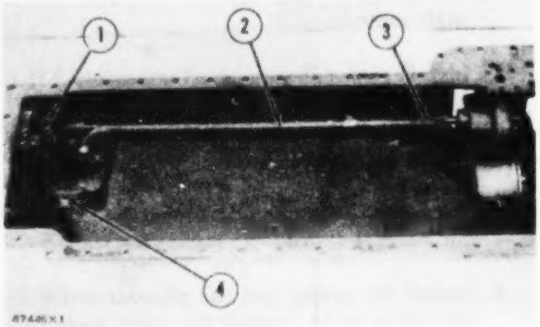
2. Slide the coupling (1) toward the oil pump until the drive shaft (3) for the oil pump drive is free.

3. Remove the bolts that hold the tube (4) for the suction bell to the oil pump and oil pump drive. Remove the tube.



4. Remove the bolts and locks that hold the oil pump drive (5) to the oil pan. Remove the oil pump drive.

INSTALL OIL PUMP DRIVE 12–1313



1. Put the oil pump drive (1) in position over its dowels on the oil pan.
2. Install bolts (4) and locks that hold it.
3. Put tube (2) in position on the oil pump and oil pump drive. Install the bolts that hold it.
4. Slide the splined coupling (3) on the drive shaft for the oil pump drive so it connects the drive shafts for the oil pump and oil pump drive.
5. Install the bolt, nut, and cotter pin that hold the coupling in position.

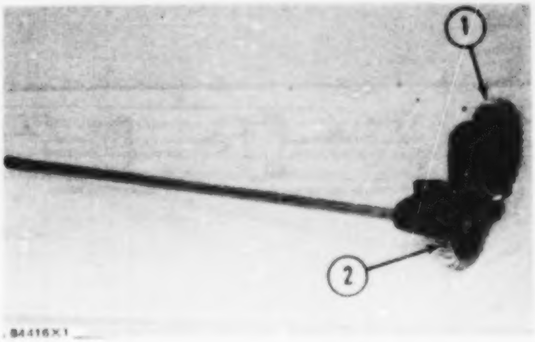
end by:
a) install oil pan (front section only)

OIL PUMP DRIVE

DISASSEMBLE OIL PUMP DRIVE 15–1313

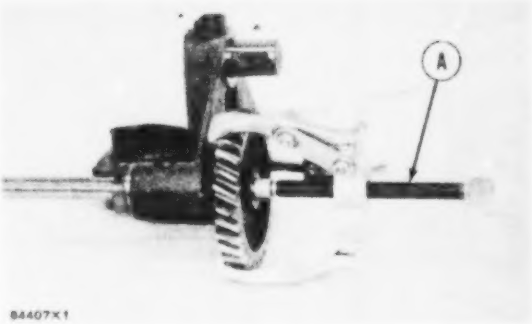
Tools Needed		A	B	C
1P2320	Puller Assembly	1		
1P458	Step Plate	1		
1P529	Handle		1	1
1P466	Drive Plate		1	
1P472	Drive Plate		1	
1P458	Drive Plate			1
1P463	Drive Plate			1

start by:
a) remove oil pump drive



1. Remove idler gear (1) from the shaft.

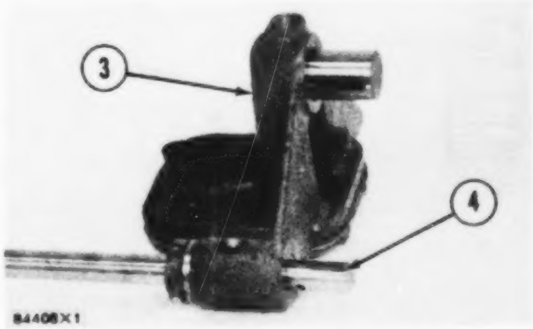
2. Use tooling (B) to remove bushing from idler gear.



3. Remove pin from drive gear (2).

4. Use tooling (A) to remove drive gear from drive shaft.

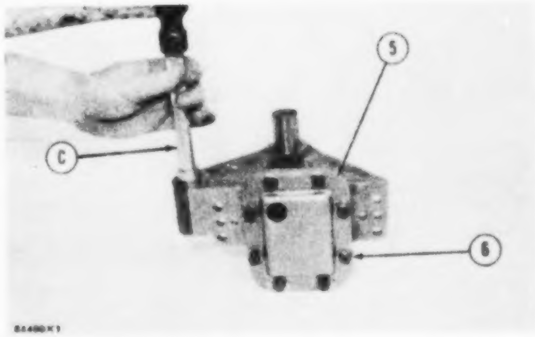
5. Remove key (4) from drive shaft and remove drive shaft from bracket (3).



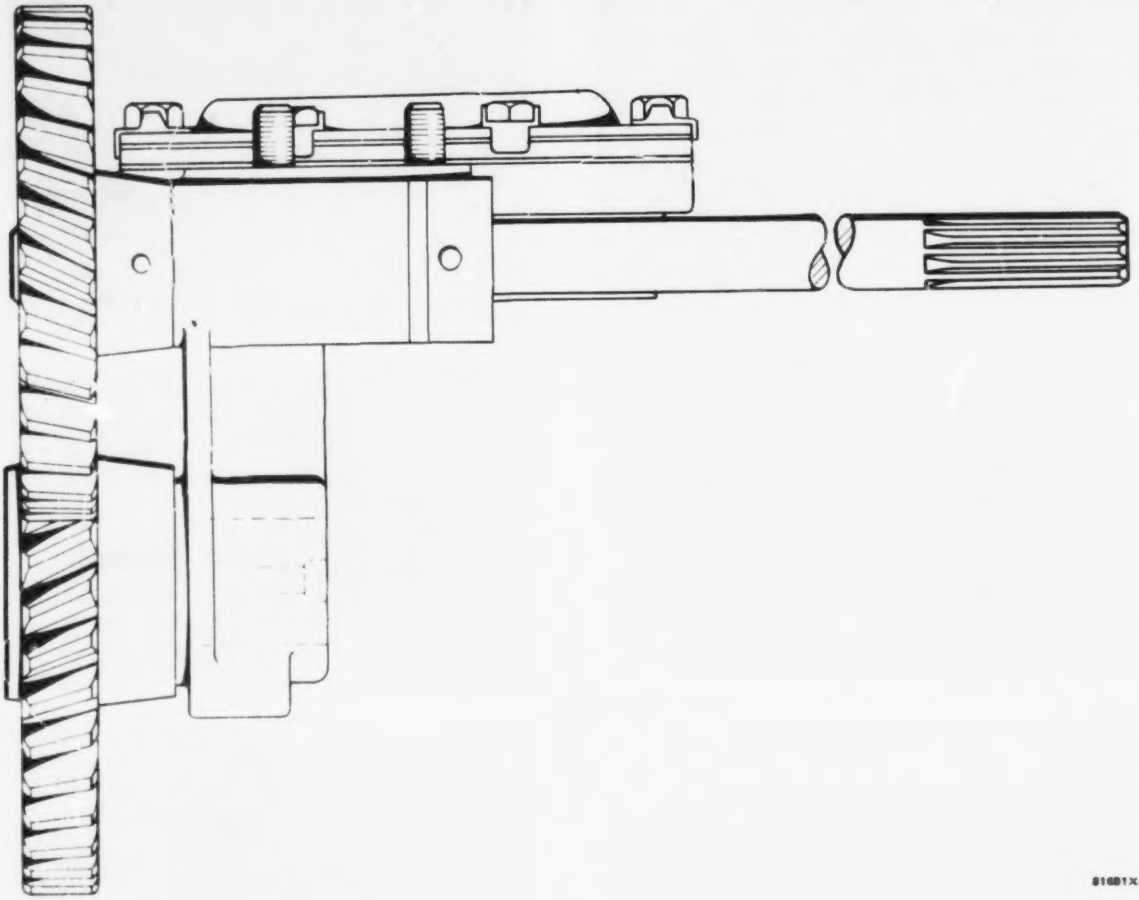
6. Use tooling (C) to remove bushing from the bracket.

7. Remove the bolts (6) and locks that hold cover on screen assembly.

8. Remove the cover (5), gaskets and screen.



OIL PUMP DRIVE

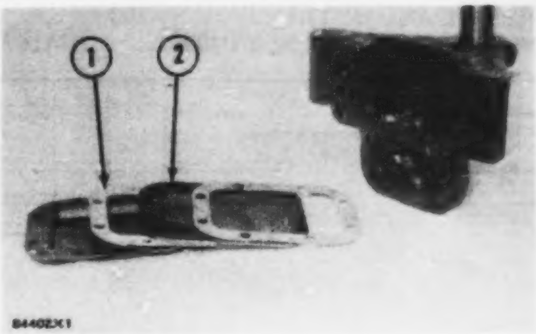


OIL PUMP DRIVE

ASSEMBLE OIL PUMP DRIVE 16–1313

Tools Needed		A	B
1P529	Handle	1	1
1P473	Drive Plate	1	
1P458	Drive Plate	1	
1P475	Drive Plate		1
1P466	Drive Plate		1

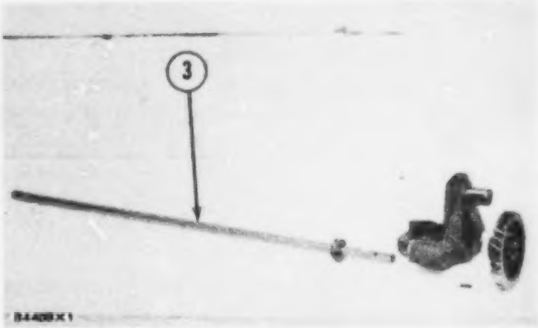
1. Clean the screen for the pump drive.



2. Put gaskets (1), screen (2) and cover in place, and install the bolts and locks.

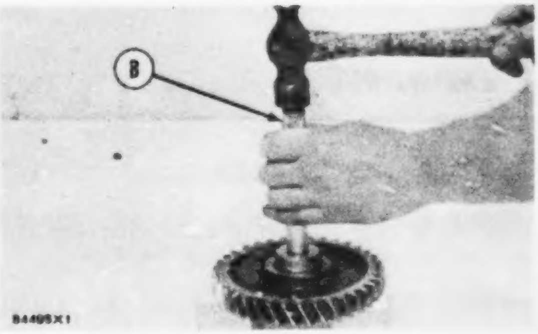
3. Use tooling (A) to install bushing in the bracket.

4. Install drive shaft (3) into bracket and install key on the shaft.



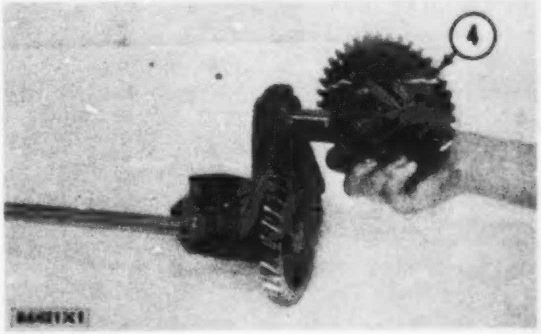
5. Heat drive gear in oil to a maximum temperature of 275°F (135°C) and install on drive shaft. Make sure the holes in gear are in alignment with hole in drive shaft.

6. Install pin with a taper into gear. Make the pin flat on end that is driven through.



7. Use tooling (B) to install bushing into idler gear.

8. Install idler gear (4) on to shaft.



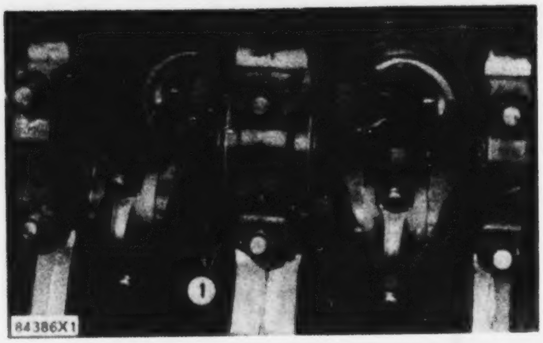
end by:
a) install oil pump drive

CRANKSHAFT MAIN BEARINGS

REMOVE AND INSTALL CRANKSHAFT MAIN BEARINGS 10–1203

Tools Needed		A	B	C
2P5517	Main Bearing Removal & Installation Tool	1		
5B1161	Wire		•	
8S2328	Dial Test Indicator Group			1

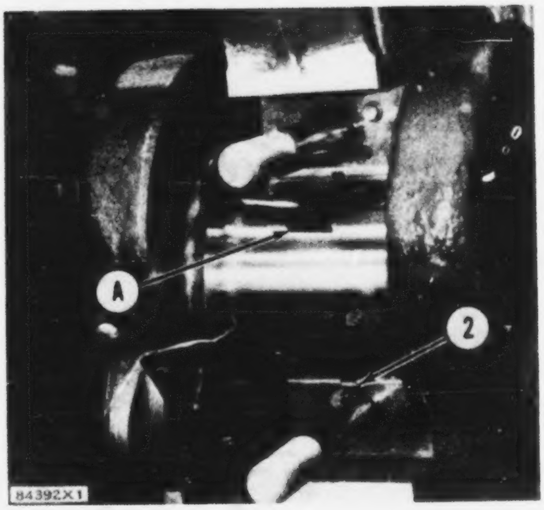
start by:
a) remove oil pan



1. Remove No. 2 through No. 6 main bearing caps (1).

2. Use tool (A) to remove the upper halves of main bearings by putting tool in drilled oil hole in crankshaft. Turn the crankshaft in the direction which will push the bearing tab out first.

CAUTION: If crankshaft is turned in the wrong direction, the tab of the bearing will be pushed between the crankshaft and cylinder block. This can cause damage to either or both.



3. Remove the lower halves of bearings from bearing caps.

4. Install new bearings in the bearing caps. Put clean engine oil on the bearings.

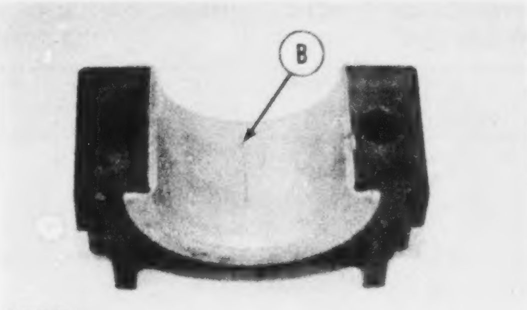
5. Use tool (A) to install the upper halves of main bearings.

NOTE: Be sure the tabs (2) on back of bearing fit in tab (slots) grooves of cap and cylinder block.

CRANKSHAFT MAIN BEARINGS

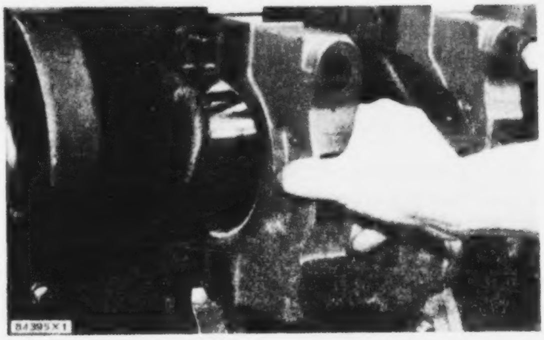
6. Install main bearing caps for No. 2 through No. 6. Remove No. 1 and No. 7 caps. Do Steps 1 through 5 for No. 1 and No. 7 caps.

7. Use wire (B) to check bearing clearance.



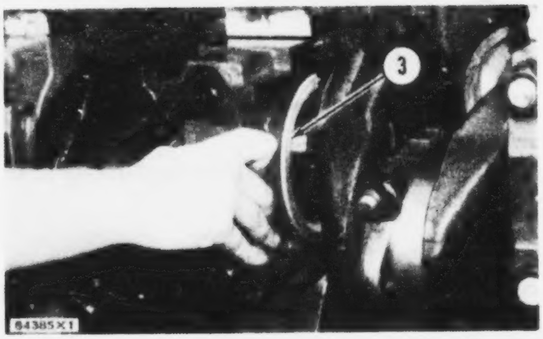
84393X1

8. Install bearing caps and tighten nuts evenly to 100 ± 5 lb.ft. (13.8 ± 0.7 mkg) plus 120° ± 5° more. Remove caps and check thickness of wire (B) to find bearing clearance. Bearing clearance must be .004 to .007 in. (0.101 to 0.178 mm) with new parts. Maximum permissible clearance with used parts is .010 in. (0.254 mm).



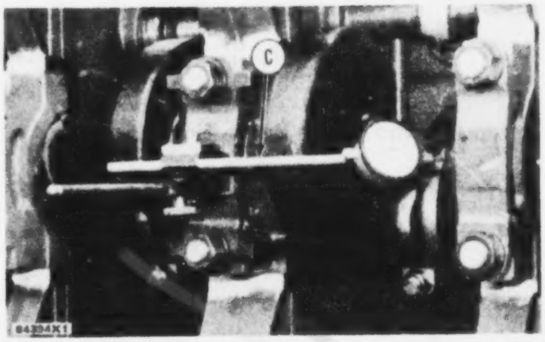
84395X1

NOTE: Be sure bearing caps are installed so number on cap is same as number on cylinder block. Both numbers must be on same side of cylinder block.



84385X1

9. Put clean engine oil on threads of studs and seat for nuts. Install main bearing caps and tighten nuts to 100 ± 5 lb.ft. (13.8 ± 0.7 mkg). Put a mark on nuts and on caps. Tighten nuts 120° ± 5° more from the mark.



84394X1

10. Use indicator group (C) to check end play of crankshaft, as controlled by lower half of center main bearing (3). End play with new parts must be .012 to .019 in. (0.30 to 0.48 mm). Maximum permissible end play with used parts is .035 in. (0.89 mm).

end by:
  a) install oil pan

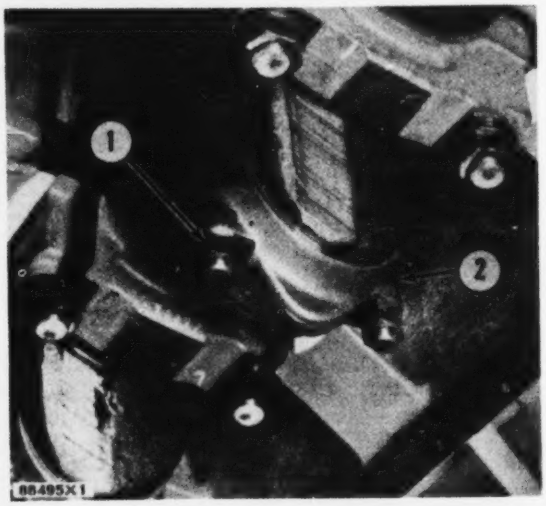
CONNECTING ROD BEARINGS

REMOVE AND INSTALL CONNECTING ROD BEARINGS 10–1219

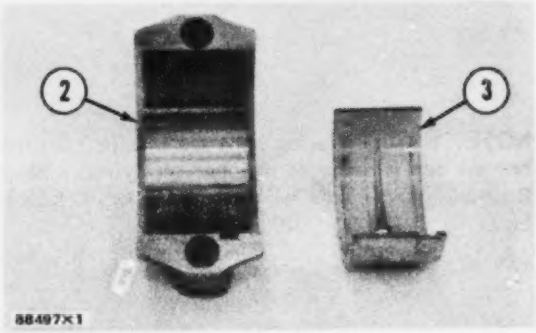
Tools Needed		A
5B1161	Wire	•

start by:
a) remove oil pan

1. Turn the crankshaft until the connecting rod caps are down.



2. Remove nuts (1) and cap (2) from the connecting rods. Remove the lower half of the bearing (3) from the cap.



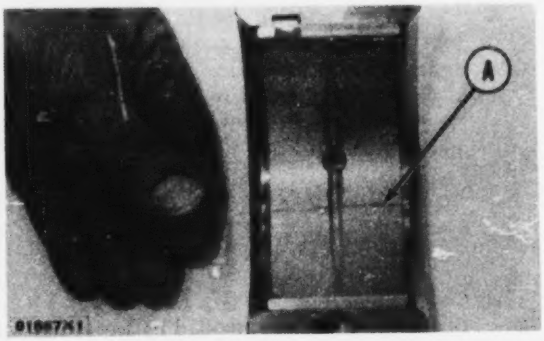
3. Push the connecting rod away from the crankshaft. Remove the upper half of the bearing from the connecting rod.

4. Install the upper half of the bearing in the connecting rod. Put clean engine oil on the bearing and journal of the crankshaft.

5. Pull the connecting rod slowly on to the crankshaft.

6. Install the lower half of the bearing in the cap.

NOTE: Be sure the tabs in the back of the bearings are in the tab (slots) grooves of the connecting rods and caps.



7. Check the bearing clearances with wire (A).

8. Put wire (A) on the bearing.

CONNECTING ROD BEARINGS

9. Put clean engine oil on the threads of the rod bolts (4) and seat surfaces.

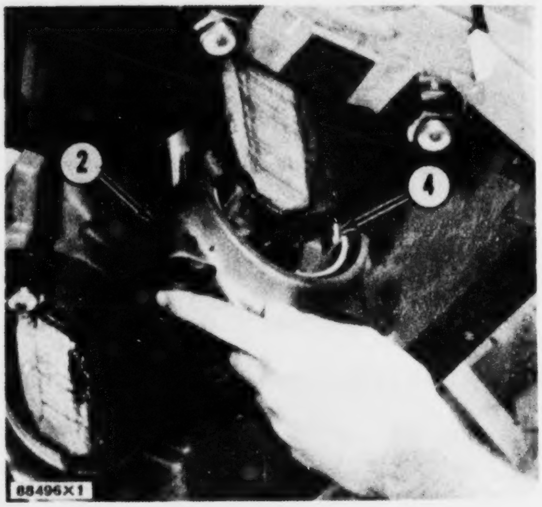
10. Install rod caps (2). Install the nuts that hold the caps to the connecting rod. Tighten each nut to torque of 75 ± 5 lb.ft. (10.4 ± 0.7 mkg). Put a mark on the nuts and caps and tighten nuts an extra 60° ± 5° from the mark. Remove the rod caps and check the bearing clearance from (A). The permissible clearance for a new bearing is .0029 to .0070 in. (0.074 to 0.178 mm). The maximum permissible clearance for a used bearing is .012 in. (0.30 mm).

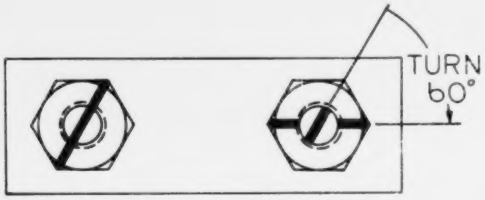
11. Put clean engine oil on the lower half of the bearings. Install the rod cap again. Tighten each nut to a torque of 75 ± 5 lb.ft. (10.4 ± 0.7 mm). Put a mark on the nuts and cap and tighten each nut 60° ± 5° more from the mark.

NOTE: Be sure the numbers on the rod cap and rod are the same and are on the same side of the connecting rod.

12. Do Steps 1 through 11 for the remainder of the bearings.

end by:
a) install oil pan

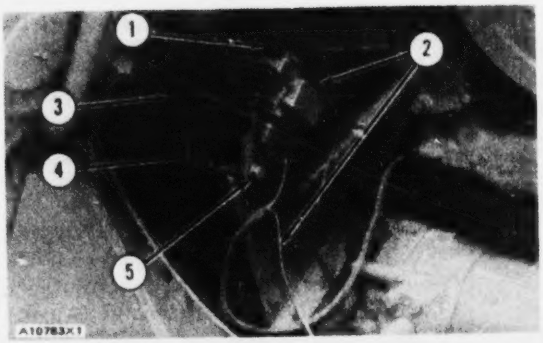




ALTERNATOR, ELECTRIC STARTING MOTOR

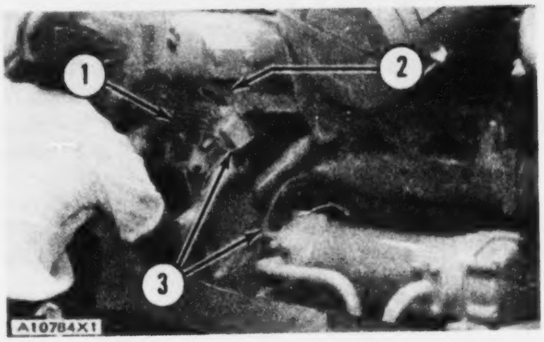
REMOVE ALTERNATOR 11–1405

1. Put identification on electric wires (2) as to their location on the alternator. Disconnect the wires from the alternator.
2. Remove adjustment bolt (1). Loosen nut (4). Move alternator toward the engine. Move alternator belt (3) free of the alternator pulley.
3. Remove nut (4) and bolt (5). Remove the alternator.



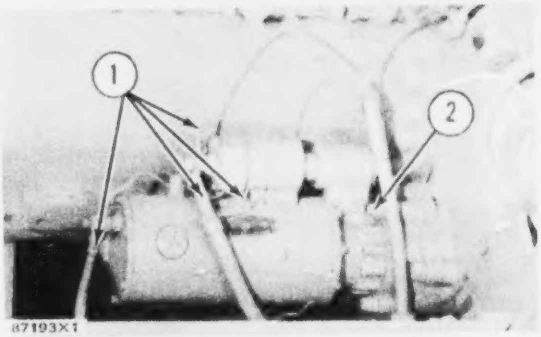
INSTALL ALTERNATOR 12–1405

1. Put the alternator (1) in position on its bracket. Install the bolt and nut that holds it.
2. Install the alternator belt on the alternator pulley. Install the adjustment bolt through strap (2) into the alternator. Put the correct tension on the belt. See DRIVE BELTS in LUBRICATION AND MAINTENANCE GUIDE. Tighten the adjustment bolt.
3. Connect the wires (3) to their correct location on the alternator.



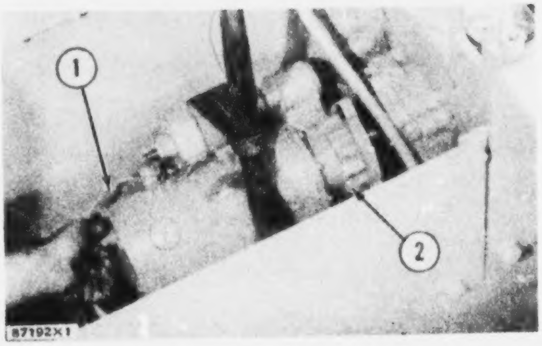
REMOVE ELECTRIC STARTING MOTOR 11–1453

1. Remove the bolts that hold the tool box to the frame. Remove the tool box from over the motor.
2. Put identification on the electric wires (1) as to their location on the motor. Disconnect the wires from the motor.
3. Fasten a hoist to the motor. Remove the bolts (2) that hold the motor to the flywheel housing.
4. Remove the electric starting motor. Weight is 75 lb. (34 kg).



INSTALL ELECTRIC STARTING MOTOR 12–1453

1. Fasten a hoist to the electric starting motor (2). Put it in position on the flywheel housing. Install the bolts that hold it.
2. Connect the wires (1) to their correct location on the motor.
3. Put the tool box in position on the frame. Install the bolts that hold it.

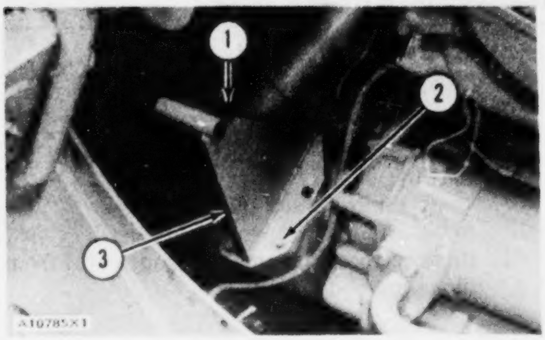


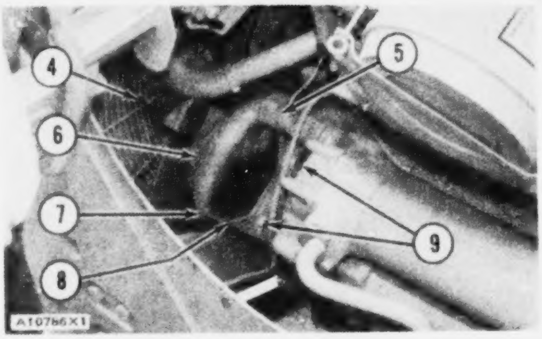
WATER PUMP

REMOVE WATER PUMP 11–1361

start by:
a) remove alternator

1. Drain the coolant from the engine.
2. Remove bolts (2) and alternator bracket (3).
3. Disconnect bypass line (1) from the water pump. Loosen the hose clamp on the hose at the water temperature regulator housing. Move the line out of the way of the water pump.
4. Remove the bolts and fan guard (4) from the left side of the radiator. Move the fan guard out of the way of the water pump.
5. Remove plate (8).
6. Disconnect inlet line (5).
7. Disconnect outlet line (7) from the water pump.
8. Remove the nuts and bolts (9) that hold the water pump to the timing gear cover. Remove water pump (6).

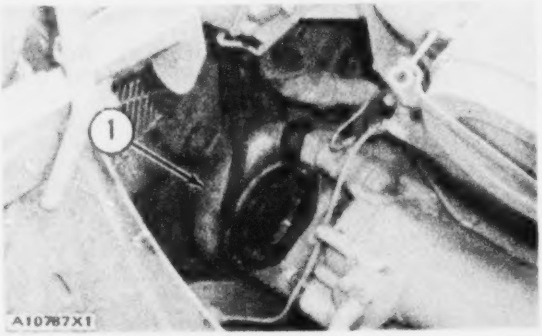


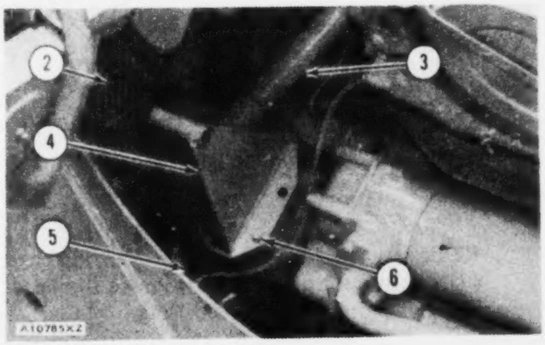


INSTALL WATER PUMP 12–1361

1. Fasten a hoist to the water pump. Put the water pump (1) in position on the timing gear cover. Install the bolts and nuts that hold the water pump in position. Remove the hoist.
2. Put fan guard (2) in position on the left side of the radiator. Install the bolts and washers that hold it.
3. Connect outlet line (5) to the water pump.
4. Connect bypass line (3) and inlet line to the water pump.
5. Install the plate over the water pump.
6. Install the alternator bracket (4) and bolts (6) that hold it.
7. Tighten the clamp on the hose at the water temperature regulator housing.
8. Fill the cooling system with coolant to the correct level. See LUBRICATION AND MAINTENANCE GUIDE.

end by:
a) install alternator





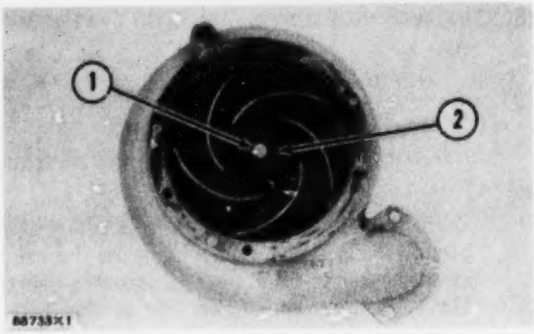
WATER PUMP

DISASSEMBLE WATER PUMP 15–1361

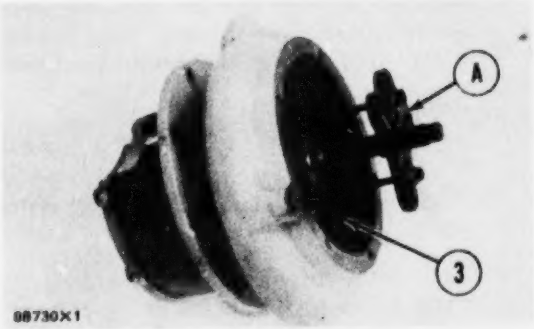
	Tools Needed	A
8S2264	Puller Group	1
1B2716	Bolt	2
4F3714	Washer	2

start by:
a) remove water pump

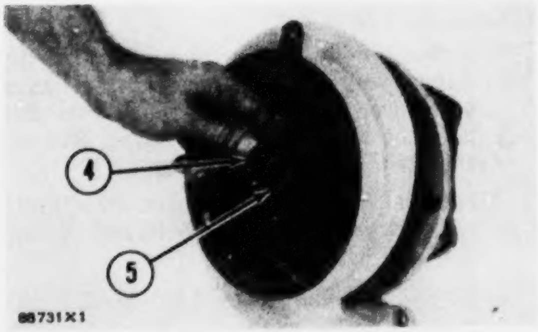
1. Remove the bolts and the front cover from the pump body.



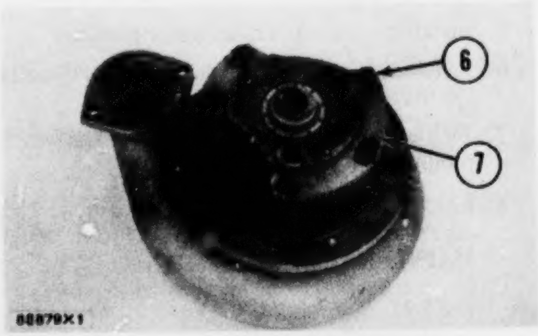
2. Remove bolt (1) and washer (2).



3. Remove the impeller (3) from the shaft with tooling (A).



4. Remove carbon seal (4) and ring (5) from the shaft.

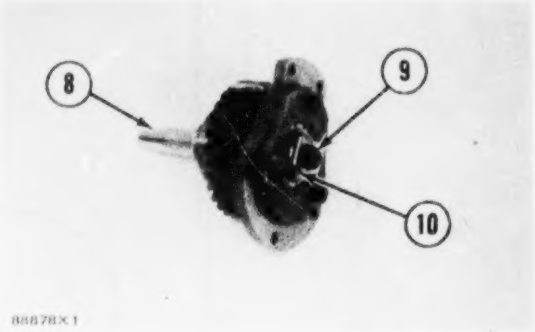


5. Remove bolts (6) that hold the bearing cage (7) to the pump housing. Remove the bearing cage from the pump housing.

WATER PUMP

6. Remove bolt (9) and retainer (10) from the shaft.

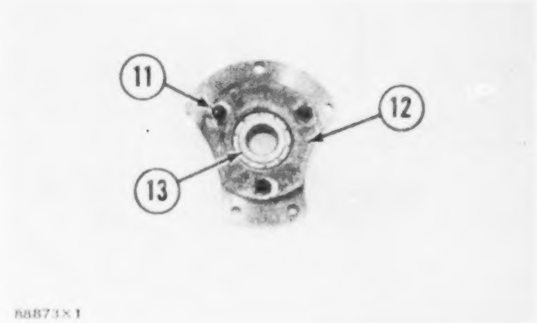
7. Remove shaft (8) from the bearing cage.



88878X1

8. Remove bolts (11) and retainer (12) from the bearing cage.

9. Remove bearing (13) from the bearing cage.



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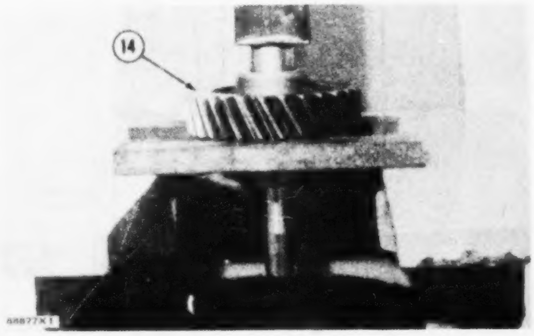
10. Remove gear (14) from the shaft using a press. Remove the key from the shaft.

11. Remove the bearing from the shaft with a press.



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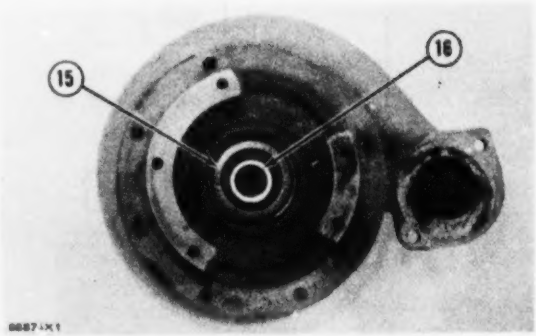
12. Remove lip type seal (15) from the pump housing.

13. Remove seal assembly (16) from the pump housing.



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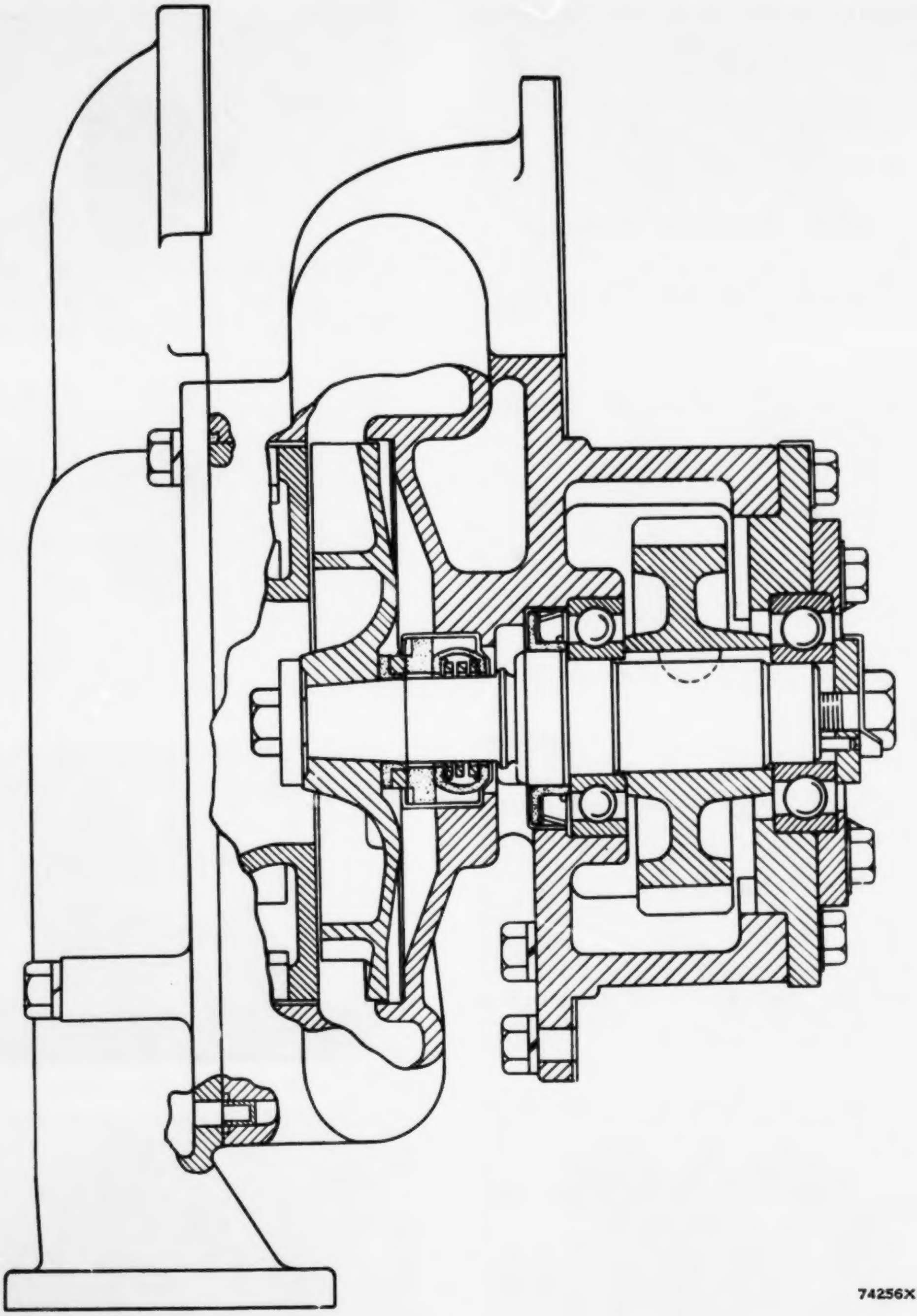
WATER PUMP

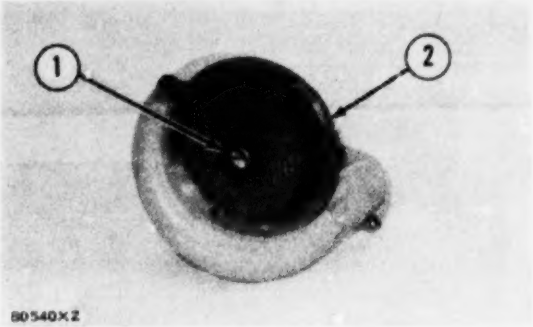


74256X2

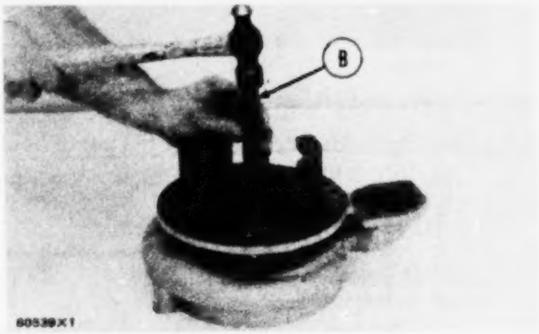
WATER PUMP

ASSEMBLE WATER PUMP 16–1361

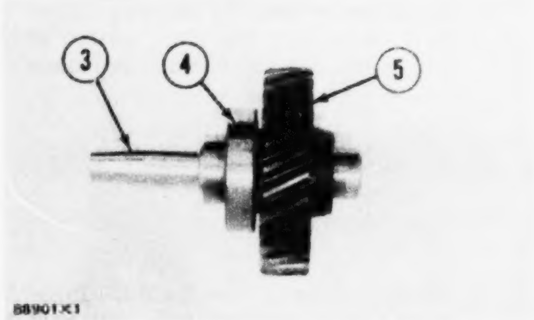
Tools Needed		A	B	C
9S8100	Fuel Transfer and Water Pump Reconditioning Tool Group	1		
1P529	Handle		1	1
1P472	Drive Plate		1	
1P491	Drive Plate		1	
1P465	Drive Plate			1
1P486	Drive Plate			1



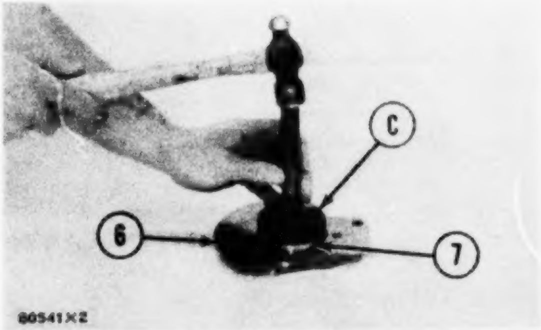
1. Install seal assembly (1) in pump housing (2) with tool group (A).



2. Install the lip type seal in the pump housing with tooling (B). Make sure the rubber lip of the seal is toward the bearing on the shaft. Put a light amount of clean engine oil on the rubber lip of the seal.



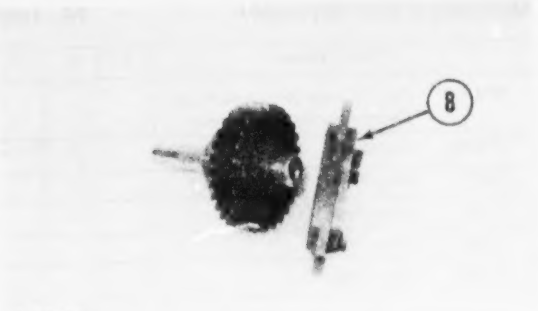
3. Heat bearing (4) and gear (5) in oil to a maximum temperature of 275°F (135°C). Install the bearing on shaft (3). Install the key on the shaft. Put the groove in the gear in alignment with the key. Install the gear on the shaft.



4. Install bearing (7) in bearing cage (6) with tooling (C).

WATER PUMP

5. Put retainer (8) in position on the bearing cage. Install the bolts that hold it.



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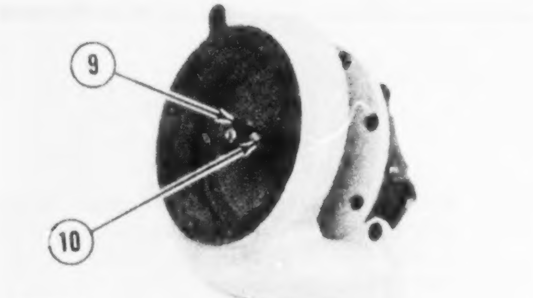
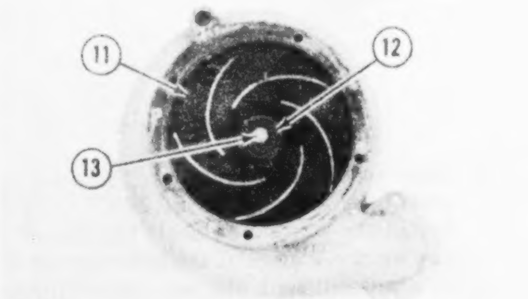
6. Install the bearing cage on the shaft. Install the retainer and bolt that hold it.



82535X3

7. Put the shaft in position in the pump housing. Install the bolts that hold it.

8. Install carbon seal (1) and ring (9) on the shaft. Make sure the shiny surface of the ring makes contact with the seal assembly.



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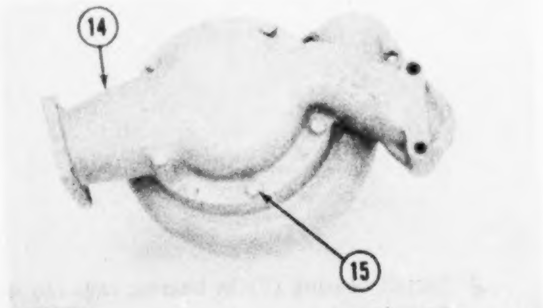
9. Install impeller (11) on the shaft. Install the washer (12) and bolt (13) that hold the impeller.



86732X1

10. Put cover (14) in position on the pump housing. Install the bolts (15) that hold it.

end by:
 a) install water pump

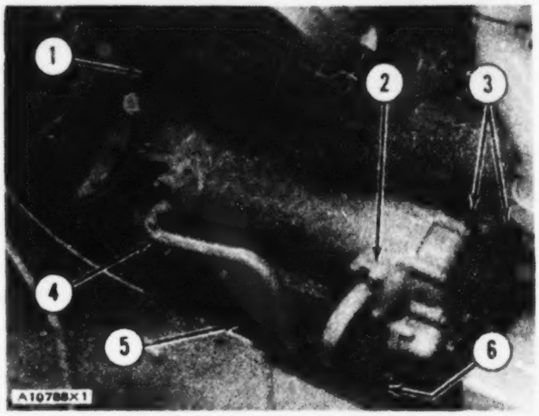
TRANSMISSION AND ENGINE OIL COOLERS

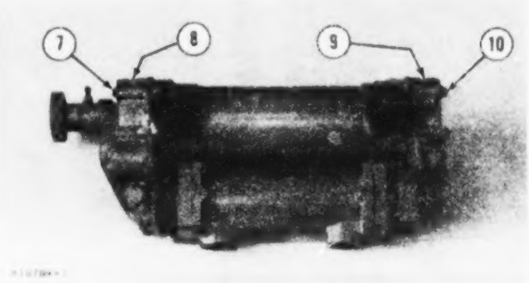
REMOVE TRANSMISSION AND ENGINE OIL COOLERS 11–1361 & 1375

start by:
a) remove hood
b) remove crankcase guards

NOTE: The coolers shown are for the POWER SHIFT MACHINE. Removal and installation of the coolers is basically the same for the DIRECT DRIVE MACHINE.

1. Drain the oil from the engine. Drain the coolant from the engine.
2. Disconnect the two oil tubes (4) and (2) from the transmission oil cooler.
3. Disconnect line (1) from the bonnet.
4. Disconnect two tubes (5) and (6) from the engine oil cooler.
5. Fasten a hoist to the transmission and engine oil coolers. Weight of the unit is 184 lb. (83 kg). Remove the four bolts (3) and washers from both bonnets. Remove the unit from the machine.
6. Remove bolts (7) and bolts (10) from the two bonnets. Remove the bonnets (8) and (9). Remove the gaskets from the bonnets.

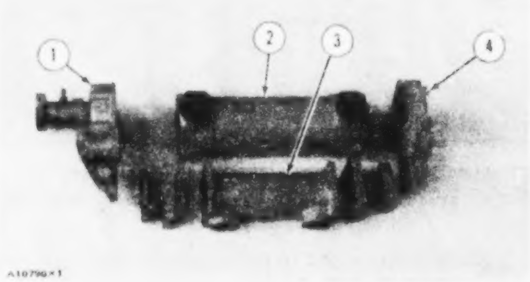


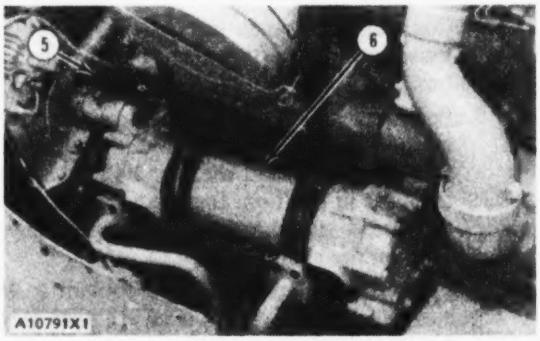


INSTALL TRANSMISSION AND ENGINE OIL COOLERS 12–1361 & 1375

1. Clean the tube bundles in core assemblies (2) and (3) with a .172 in. (4.37 mm) diameter rod.
2. Install new gaskets on bonnets (1) and (4).
3. Install the two bonnets on the core assemblies. Install the bolts and washers that hold the bonnets in position.
4. Fasten a hoist to the transmission and engine oil coolers. Put the unit in position against the cylinder block. Install the eight bolts and washers that hold the unit in position. Remove the hoist from the transmission and engine oil coolers (6).
5. Connect the two tubes to the engine oil cooler.
6. Connect the two oil tubes to the transmission oil cooler.
7. Connect line (5) to the bonnet on the transmission oil cooler.
8. Fill the engine with oil and the cooling system with coolant to the correct levels. See LUBRICATION AND MAINTENANCE GUIDE.

end by:
a) install crankcase guards
b) install hood



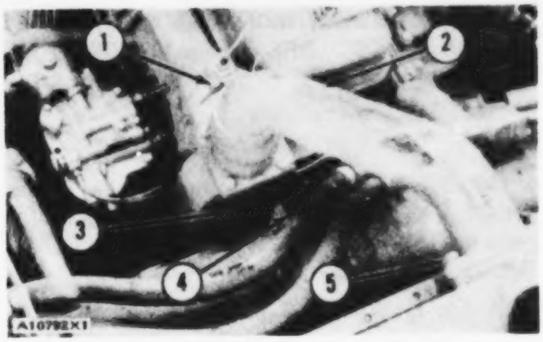


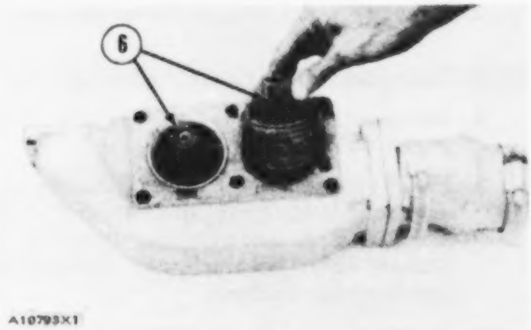
WATER TEMPERATURE REGULATORS

REMOVE WATER TEMPERATURE REGULATORS 11–1355

start by:
a) remove hood

1. Drain the coolant from the cooling system.
2. Loosen clamp (1). Remove bolts (5). Remove tube (2) from the cover to the radiator.
3. Disconnect bypass line (4) from the cover.
4. Remove bolts (3) that hold the cover to the water manifold. Remove the cover.
5. Remove the two water temperature regulators (6) from the cover. Remove the two seals from the cover.



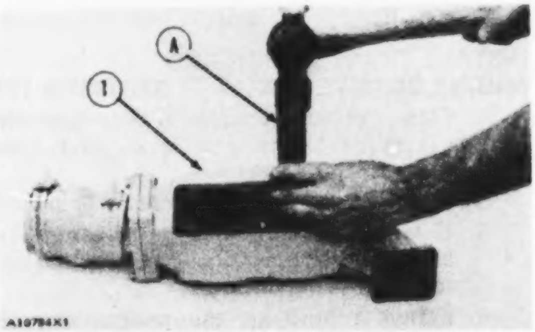


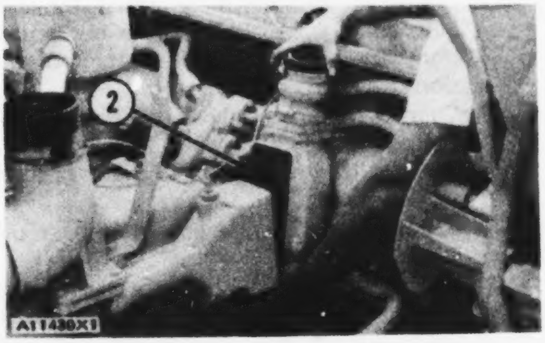
INSTALL WATER TEMPERATURE REGULATORS 12–1355

	Tools Needed	A
1P532	Handle	1
1P483	Drive Plate	1
1P488	Drive Plate	1

1. Install seals in cover (1) with tooling (A).
2. Install the two water temperature regulators (2) in the cover.
3. Put the cover in position on the water manifold. Install the bolts and washers that hold the cover in position.
4. Connect the bypass line to the bottom of the cover of the water temperature regulators.
5. Put a new gasket on the tube from the cover to the radiator. Put the tube in position on the radiator. Install the two bolts that hold the tube in position. Install the other end of the tube on the hose from the cover. Tighten the clamp.
6. Fill the cooling system with coolant to the correct level. See LUBRICATION AND MAINTENANCE GUIDE.

end by:
a) install hood





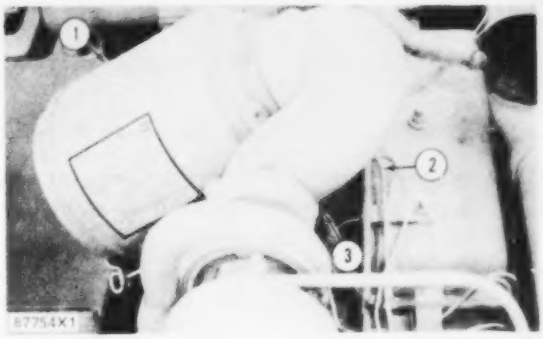
AIR CLEANER ASSEMBLY

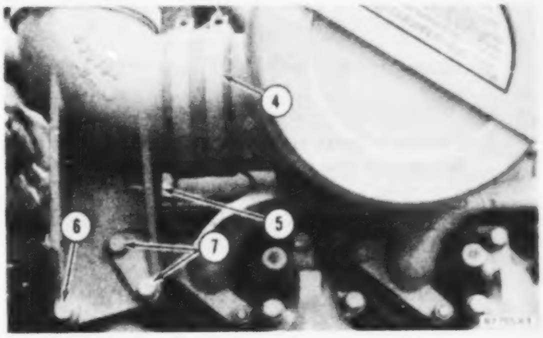
REMOVE AIR CLEANER ASSEMBLY 11–1051

start by:
a) remove hood

1. Disconnect line (2) from the air cleaner indicator.
2. Remove bolts (3) that hold the air cleaner bracket to the cylinder head.
3. Remove two bolts (7). Loosen bolt (6). Loosen hose clamp (4). Move precleaner elbow (5) forward until it is free of the air cleaner assembly.
4. Fasten a hoist to the air cleaner assembly. Move the air cleaner asembly forward until it is free of the turbocharger. Remove the air cleaner assembly (1). Weight is 68 lb. (31 kg).

CAUTION: Use care not to cause damage to the glow plugs when removing the air cleaner assembly.

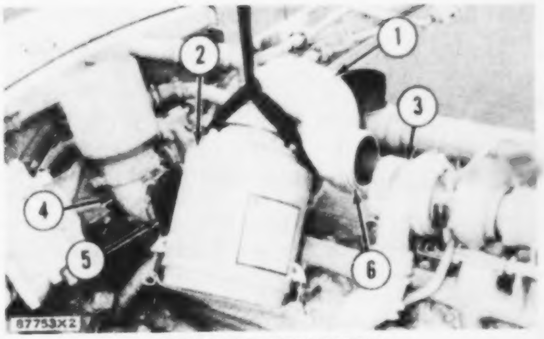




INSTALL AIR CLEANER ASSEMBLY 12–1051

1. Fasten a hoist to the air cleaner assembly (2).
2. Put clean engine oil on O-ring seals (6). Move the air cleaner assembly to the rear until elbow (1) is in position in the turbocharger (3).
3. Move precleaner elbow (4) to the rear and connect hose (5) to the air cleaner assembly. Tighten the hose clamp. Install the two bolts that hold the precleaner elbow to the inlet manifold. Tighten the third bolt that holds the precleaner elbow to the inlet manifold.
4. Install the bolts that hold the air cleaner bracket to the cylinder head.
5. Connect the line to the air cleaner indicator.

end by:
a) install hood



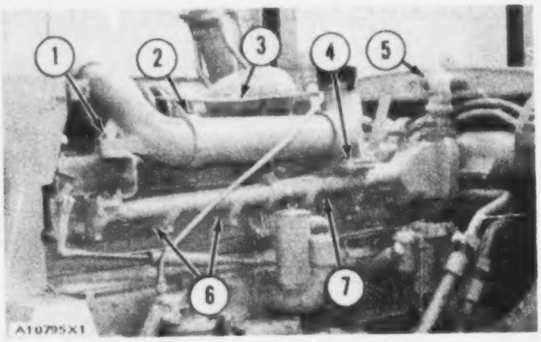
TYPICAL EXAMPLE

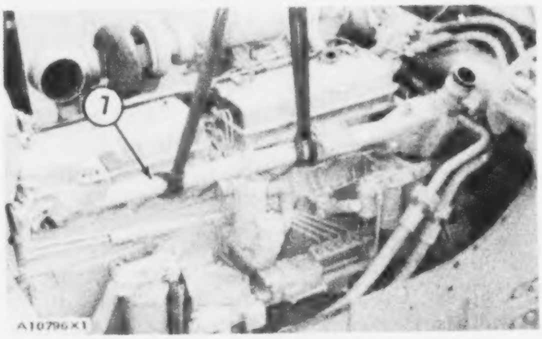
WATER MANIFOLD

REMOVE WATER MANIFOLD 11–1362

start by:
a) remove hood

1. Drain the coolant from the engine.
2. Remove tube (5) from the radiator and cover of the water temperature regulators.
3. Disconnect the bypass line from the cover.
4. Remove oil supply line (3) for the turbocharger.
5. Remove four bolts (4) and nuts from the pipe.
6. Remove two bolts (1) and nuts from the pipe.
7. Fasten a hoist to pipe (2). Remove the pipe. Weight of the pipe is 55 lb. (25 kg).
8. Fasten a hoist to the water manifold. Remove nuts (6) and washers.
9. Remove water manifold (7). Weight of the water manifold is 84 lb. (38 kg).

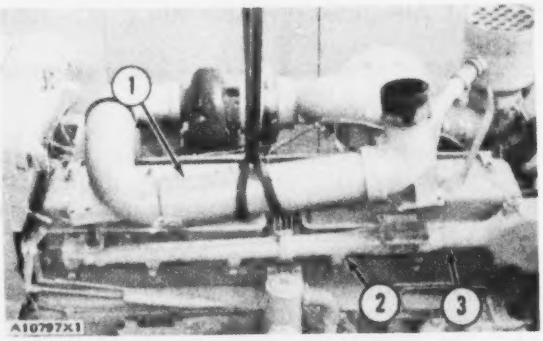


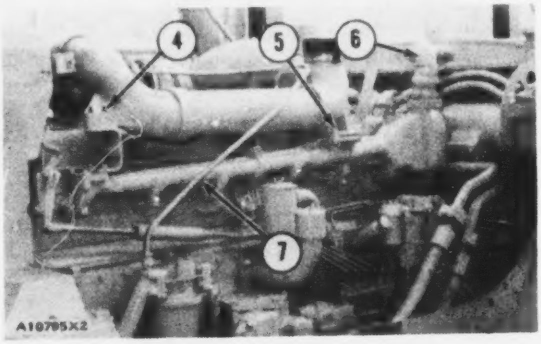


INSTALL WATER MANIFOLD 12–1362

1. Install new gaskets on the studs in the cylinder block.
2. Put the water manifold (3) in position on the studs. Install the nuts (2) and washers that hold the water manifold in position.
3. Connect the bypass line at the bottom of the cover for the water temperature regulators.
4. Fasten a hoist to pipe (1). Put the pipe in position on the water manifold.
5. Install four bolts (5) and nuts. Install two bolts (4) and nuts.
6. Connect oil supply line (7) for the turbocharger.
7. Install tube (6) from the radiator to the cover of the water temperature regulators.
8. Fill the cooling system with coolant to the correct level. See LUBRICATION AND MAINTENANCE GUIDE.

end by:
a) install hood





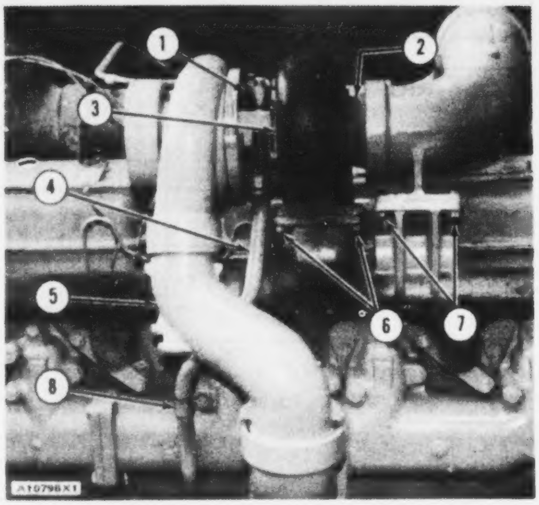
TURBOCHARGER

REMOVE TURBOCHARGER 11–1052

start by:

a) remove air cleaner assembly

1. Remove oil supply tube (1) from the turbocharger.
2. Disconnect oil drain tube (4) from the turbocharger. Remove bolt and clip (8).
3. Remove the bolts (6) and nuts that hold the turbocharger to the exhaust manifold.
4. Remove bolts (7) that hold the elbow to the exhaust manifold.
5. Fasten a hoist to the turbocharger (3). Remove the turbocharger. Weight of the turbocharger is 50 lb. (23 kg).
6. Remove coupling (2) and pipe (5) from the turbocharger.

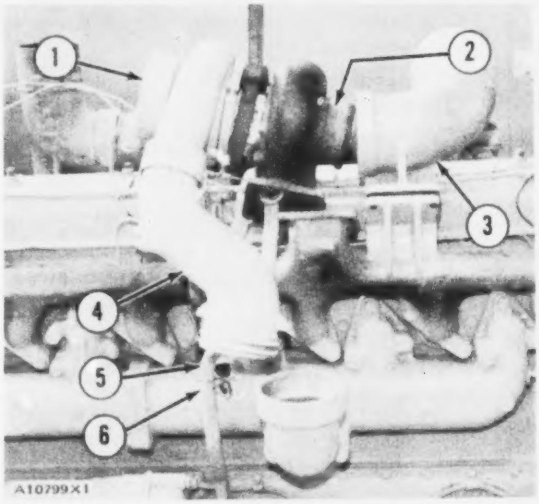


INSTALL TURBOCHARGER 12–1052

1. Put clean SAE 30 oil on the seals for pipe (4) and coupling (2). Install the pipe and coupling in the turbocharger.
2. Fasten a hoist to the turbocharger (1) and put it in position on the exhaust manifold. Make sure the coupling engages in elbow (3) and pipe (4) engages in the inlet manifold.
3. Put 9M3710 Anti-Seize Compound on the threads of the bolts that hold elbow (3) to the exhaust manifold and the bolts that hold the turbocharger to the exhaust manifold.
4. Connect drain tube (5) to the turbocharger. Fasten clip (6) to the inlet manifold.
5. Install the oil supply tube on the turbocharger.

end by:

a) install air cleaner assembly

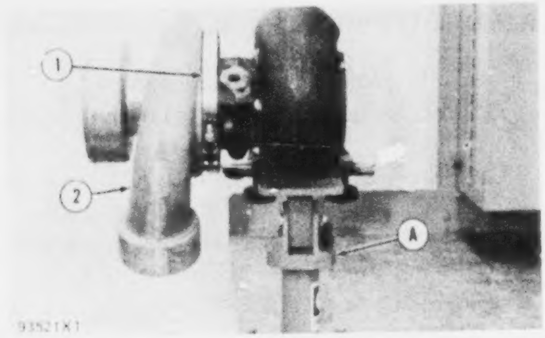


TURBOCHARGER

DISASSEMBLE TURBOCHARGER 15–1052

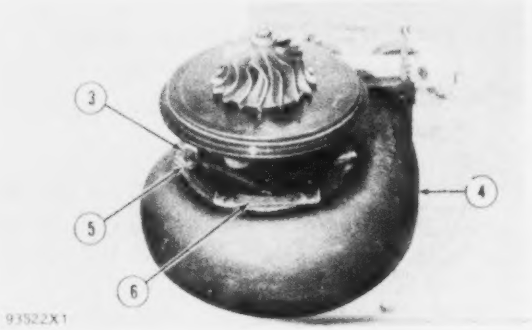
Tools Needed		A	B	C	D	E	F	G
9S6363	Holding & Positioning Fixture	1						
9S6343	Cartridge Fixture		1					
8S9944	Holder			1				
	Oil Cooker (Thermostat Controlled)				1			
FT808	Adapter					1		
FT165	Fixture						1	
FT174	Driver Tool							1

start by:
 a) remove turbocharger



1. Install the turbocharger on tool (A).

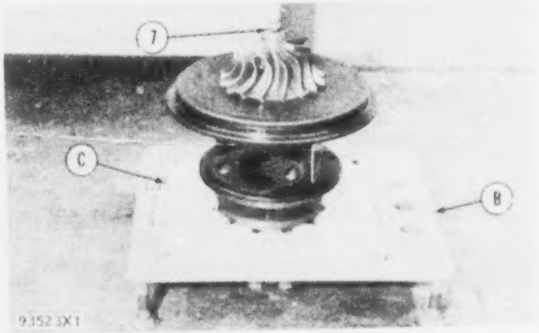
2. Put marks on the housings for correct installation at assembly.



3. Loosen clamp (1). Remove compressor housing (2). Remove the clamp.

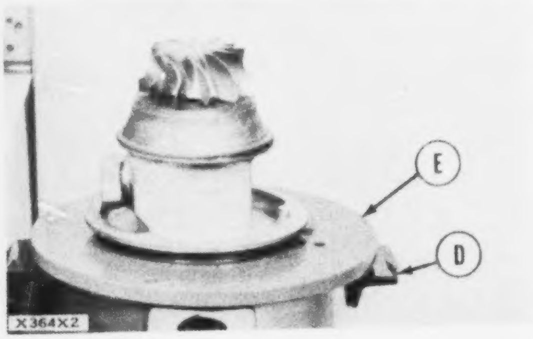
4. Remove bolts (3), locks (6), and plates (5).

5. Remove the center section from turbine housing (4).



6. Install tool (C) in tool (B). Install the center section in tool (C) as shown.

7. Remove nut (7) that holds the impeller to the shaft and wheel assembly.



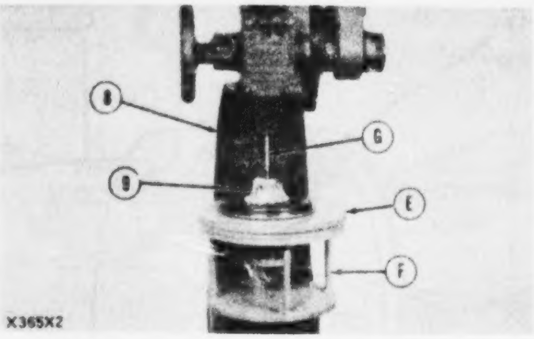
8. Install tool (E) on tool (D). Heat tool (D) to 350°F (177°C). Install the impeller on tool (E).

CAUTION: Make sure only the impeller is in the hot oil.

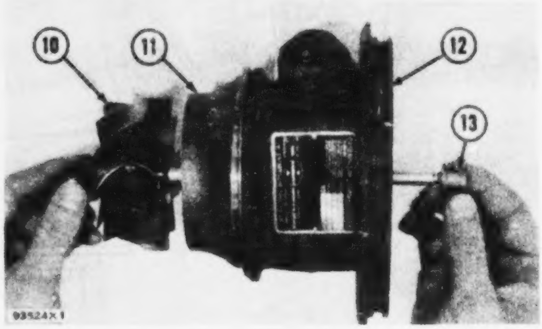
TURBOCHARGER

9. Install tool (E) with the center section on tool (F). Remove impeller (9) with an arbor press (8) and tool (G).

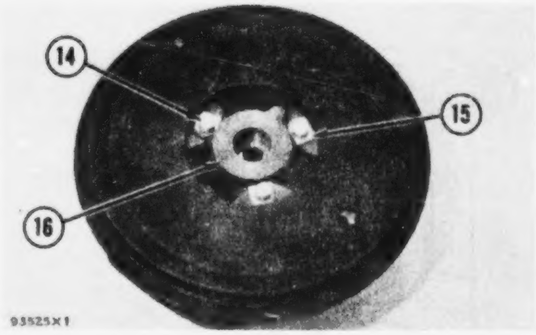
NOTE: Step 9 must be done before the impeller gets cold.


8
G
9
E
F
X365X2

10. Remove shaft and wheel assembly (10), shroud (11), and spacer (13) from center housing (12).


10
11
12
13
93524X1

11. Remove bolts (14), locks (15) and plate (16) from the center housing.
12. Remove collar (17).
13. Remove two bearings (18) and three snap rings (19) from the center housing.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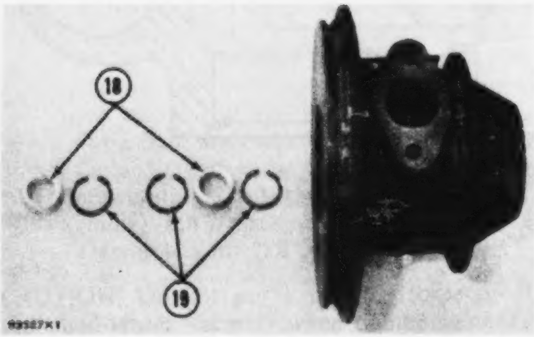
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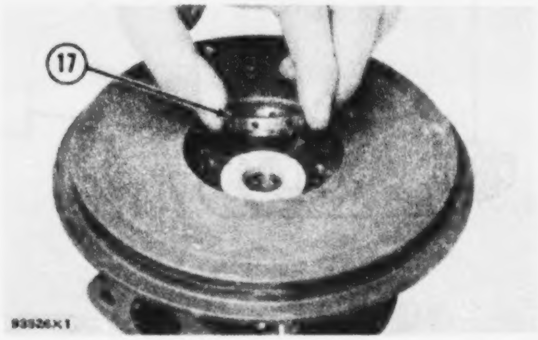
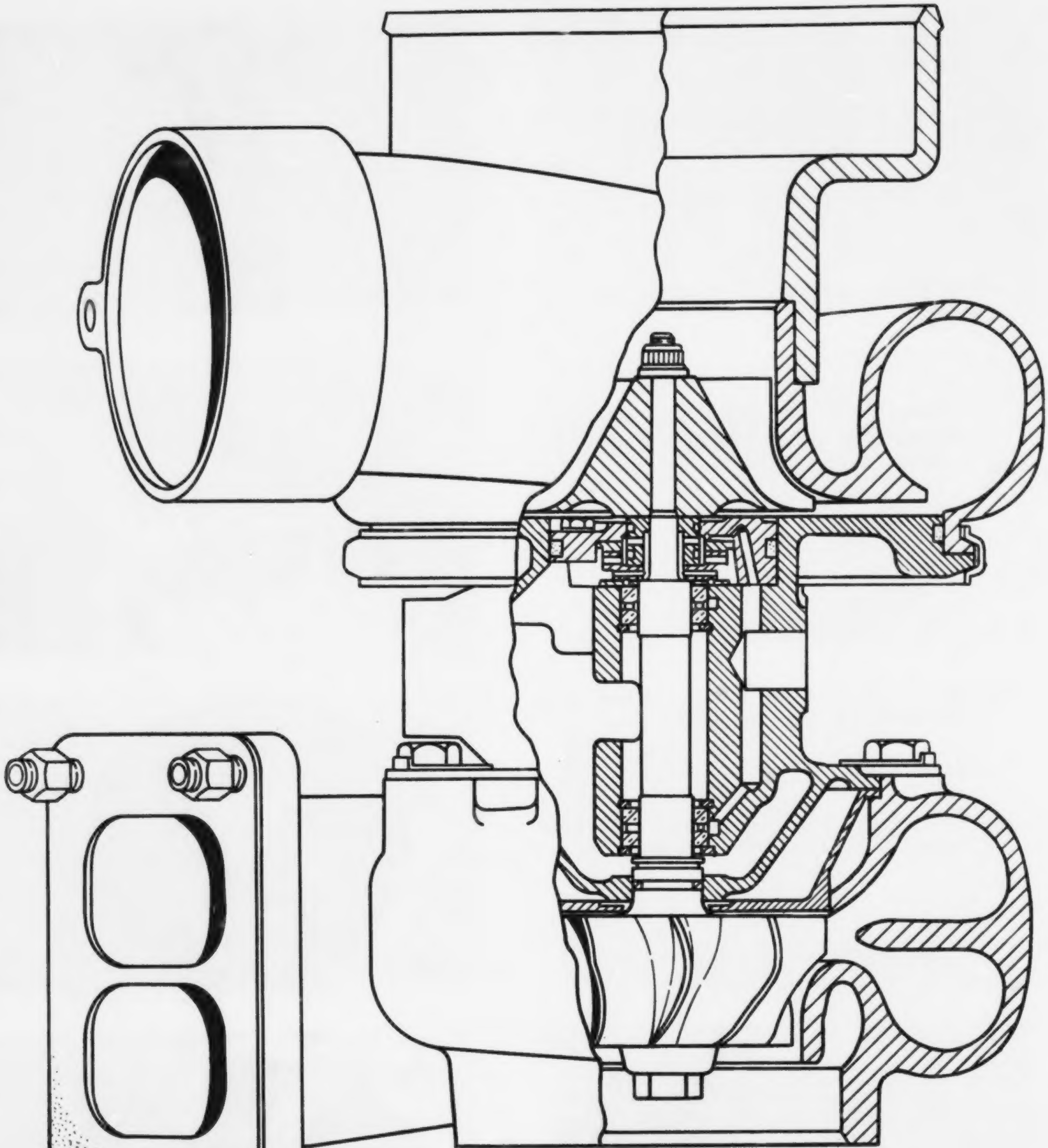


TURBOCHARGER



TURBOCHARGER

ASSEMBLE TURBOCHARGER 16–1052

Tools Needed		A	B	C	D	E
9S6363	Holding & Positioning Fixture	1				
9S6343	Cartridge Fixture		1			
8S9944	Holder			1		
FT165	Fixture				1	
FT174	Driver Tool					1

1. Clean all parts thoroughly before assembling.
2. Install snap ring (15), bearing (12), and snap ring (11) in center housing (10). Install snap ring (9) and bearing (8).
3. Install shroud (13) and shaft and wheel assembly (16) in the center housing.

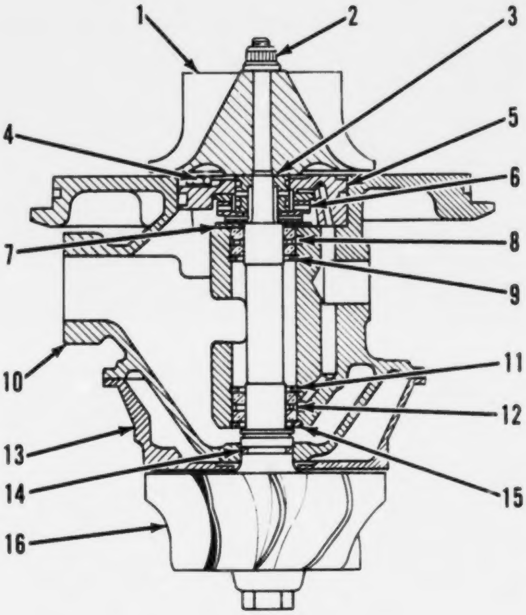
CAUTION: Use caution not to cause damage to ring seal (14) when installing the shaft and wheel assembly.

4. Install spacer (7) and collar (6).
5. Put plate (5) in position on the center housing. Install bolts (4). Tighten the bolts to a torque of 35 ± 5 lb.in. (40.4 ± 5.8 cm.kg).
6. Install spacer (3). Make sure the small inside diameter of the spacer is toward the impeller end of the shaft and wheel assembly.

CAUTION: Installing spacer (3) with its small inside diameter toward the center housing will cause a restriction of oil flow to the chamber and rings. This will cause a failure to the turbocharger.

7. Heat impeller (1) in oil to a maximum temperature of 350°F (177°C). Install the impeller on the shaft and wheel assembly.
8. Install tool (C) in tool (B). Install the center section in tool (C). Install nut (2). Tighten the nut to a torque of 120 lb. in. (138.5 cm.kg). Let the temperature of the impeller get below 150°F (70°C). Loosen the nut. Put a light amount of oil on the threads of the shaft and wheel assembly. Tighten the nut again to a torque of 30 lb.in. (34.6 cm.kg). Put a mark on the nut and impeller. Tighten the nut 120° past the mark.

CAUTION: Do not put a bending force on the shaft and wheel assembly when tightening nut (2).



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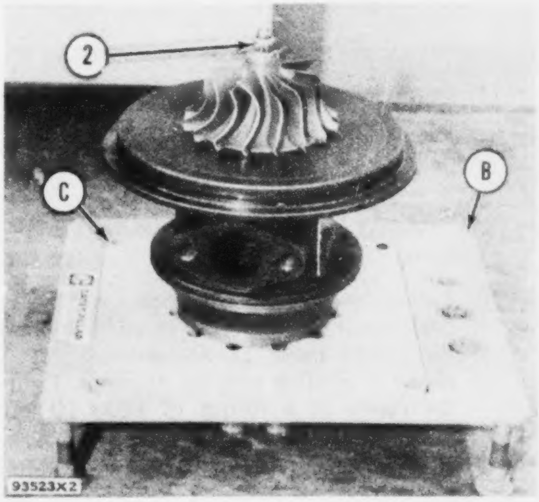
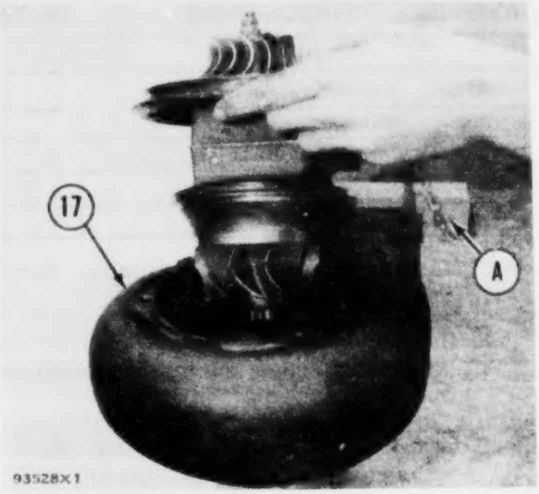


TURBOCHARGER

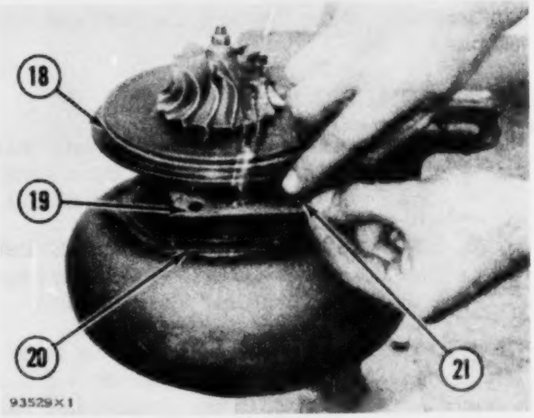
9. Install turbine housing (17) on tool (A). Install the center section in the turbine housing.

NOTE: Put the marks that were made at disassembly in alignment to make sure the housings are in their original position.



10. Put 9M3710 Anti-Seize Compound on the threads of bolts (21). Install plates (20), locks (19), and the bolts. Tighten the bolts to a torque of 175 ± 15 lb.in. (201.8 ± 17.3 cm.kg).

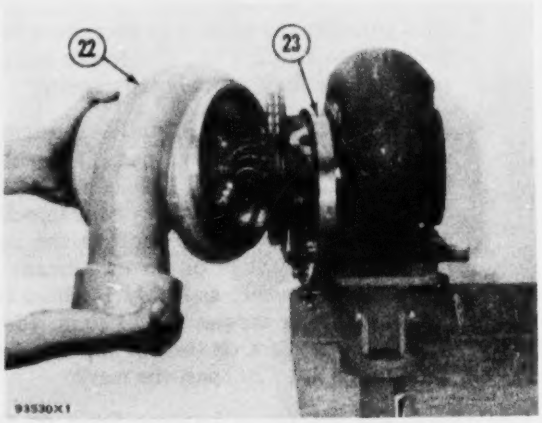
11. Install a new O-ring seal (18) on the center housing.



12. Put clamp (23) over the center section. Put compressor housing (22) in alignment with the marks made at disassembly. Put the clamp in position over the housings. Tighten the clamp to a torque of 120 ± 10 lb.in. (138.4 ± 11.5 cm.kg).

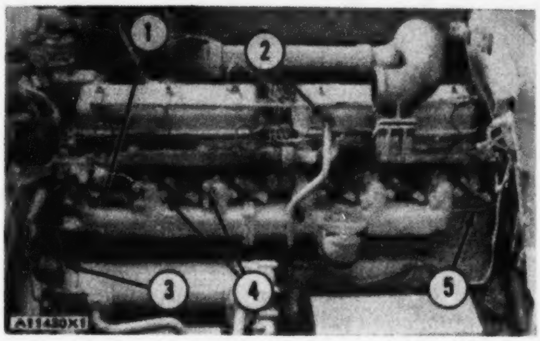
13. Put oil in the center section and turn the shaft and wheel assembly.

end by:
a) install turbocharger



INLET MANIFOLD, EXHAUST MANIFOLD

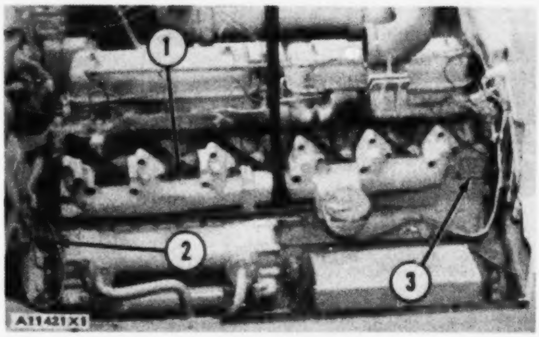
REMOVE INLET MANIFOLD 11–1058



start by:
 a) remove turbocharger

1. Disconnect air pressure line (5) for the fuel ratio control from the inlet manifold.
2. Remove outlet tube (2) for the turbocharger oil.
3. Remove wire (3) from the clip on the front of the inlet manifold.
4. Fasten a hoist to the inlet manifold. Remove bolts (4). Remove inlet manifold (1). Weight of the inlet manifold is 95 lb. (43 kg).

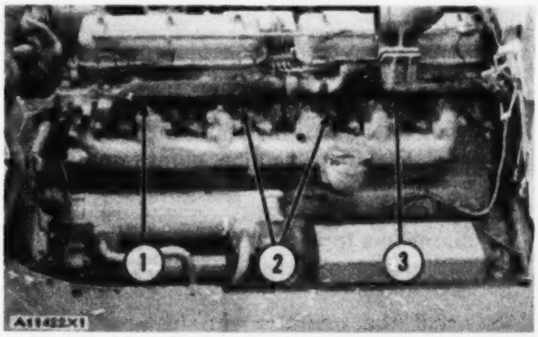
INSTALL INLET MANIFOLD 12–1058



1. Install new gaskets on the inlet manifold.
2. Fasten a hoist to the inlet manifold (1). Put it in position on the cylinder block. Install the bolts that hold it.
3. Connect air pressure line (3) for fuel ratio control to the inlet manifold.
4. Install the outlet tube for the turbocharger oil.
5. Install wire (2) in the clip on the inlet manifold.

end by:
 a) install turbocharger

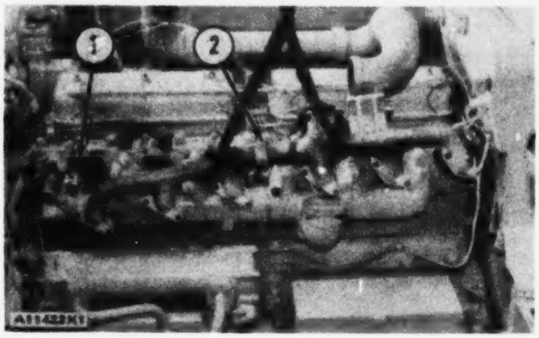
REMOVE EXHAUST MANIFOLD 11–1059



start by:
 a) remove turbocharger

1. Fasten a hoist to the front section (1) of the exhaust manifold and the rear section (3) of the exhaust manifold. Remove nuts (2). Remove the exhaust manifold. Weight of the exhaust manifold is 68 lb. (31 kg).

INSTALL EXHAUST MANIFOLD 12–1059

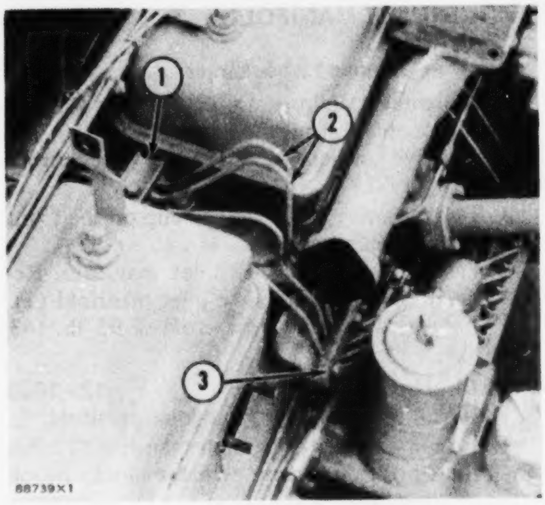


1. Put new gaskets on studs (1).
2. Put 9M3710 Anti-Seize Compound on studs (1).
3. Fasten a hoist to exhaust manifold (2) and put it in position on the studs. Install the nuts that hold it.

end by:
 a) install turbocharger

FUEL INJECTION LINES

REMOVE FUEL INJECTION LINES 11–1252

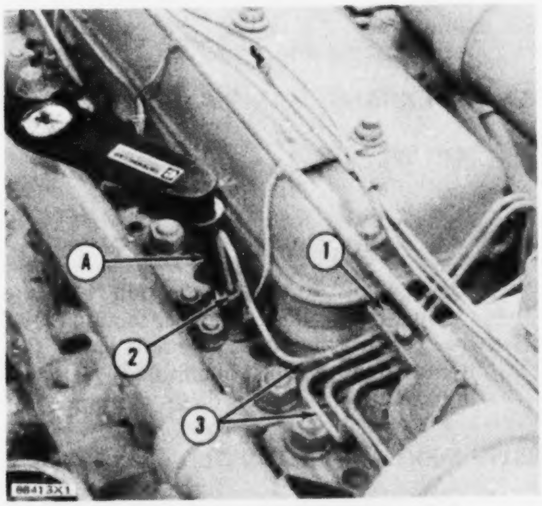


start by:
  a) remove hood
  b) remove water manifold (rear section only)

1. Remove clamps (1) and (3) and their retainers.
2. Put identification on the fuel injection lines as to their location on the fuel injection pumps and valves.
3. Disconnect the fuel injection lines from the fuel injection pumps. Put protection caps on the lines and pumps to prevent dirt and foreign material from getting into the fuel system.
4. Disconnect the fuel injection lines from the fuel injection valves. Put protection caps on the valves and lines.
5. Remove the fuel injection lines (2).

INSTALL FUEL INJECTION LINES 12–1252

	Tools Needed	A
5P144	Socket	1



1. Make sure the fuel injection lines are clean and dry.
2. Connect the fuel injection lines (3) to their respective fuel injection pumps and valves.
3. Tighten the nuts (2) on the valves and pumps to a torque of 30 ± 5 lb.ft. (4.1 ± 0.7 mkg) with tool (A).
4. Install the retainers and clamps (1) that hold the fuel injection lines to the engine.
5. Remove the air from the fuel system. See PRIMING THE FUEL SYSTEM in LUBRICATION AND MAINTENANCE GUIDE.

end by:
  a) install water manifold (rear section only)
  b) install hood

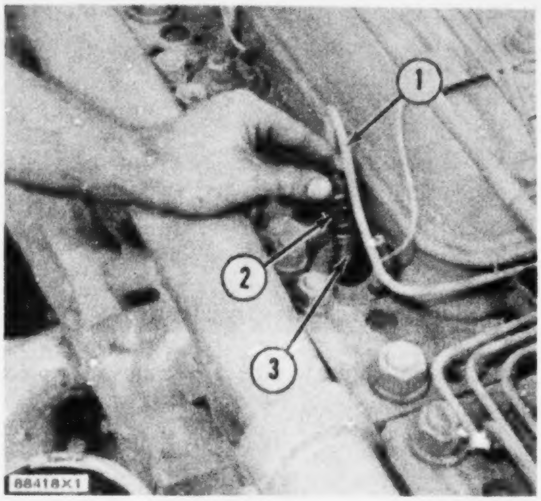
FUEL INJECTION VALVES

REMOVE FUEL INJECTION VALVES 11–1254

Tools Needed		A
5P144	Socket	1

start by:
a) remove turbocharger

1. Disconnect fuel injection lines (1) from the valves to be removed. Put covers over the openings to prevent dirt and foreign material from getting into the fuel system.
2. Remove the nut that holds the fuel injection valve in the precombustion chamber with tool (A).
3. Remove the fuel injection valve. Remove nozzle (3) from body (2).



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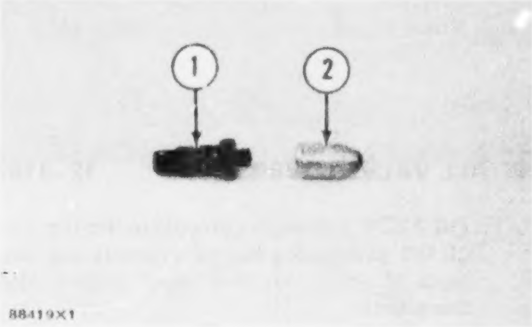
INSTALL FUEL INJECTION VALVES 12–1254

Tools Needed		A
5P144	Socket	1

1. Install nozzle (2) on body (1). Tighten the nozzle with fingers only.
2. Install the fuel injection valve in its precombustion chamber.
3. Install nut (5). Tighten the nut to a torque of 105 ± 5 lb.ft. (14.5 ± 0.7 mkg).
4. Connect the fuel injection lines (4) to their respective valve. Tighten nut (3) to a torque of 30 ± 5 lb.ft. (4.1 ± 0.7 mkg) with tool (A).

end by:
a) install turbocharger



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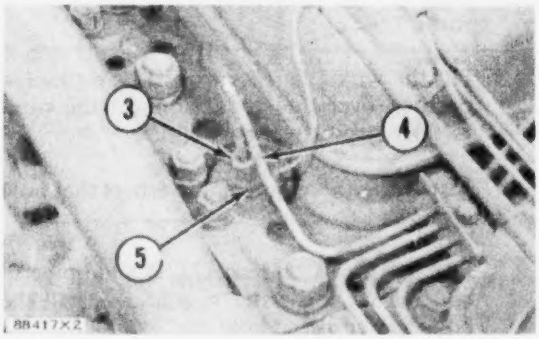

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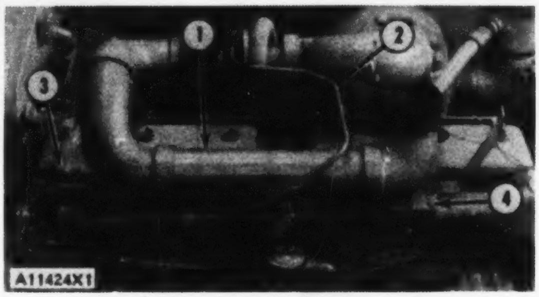
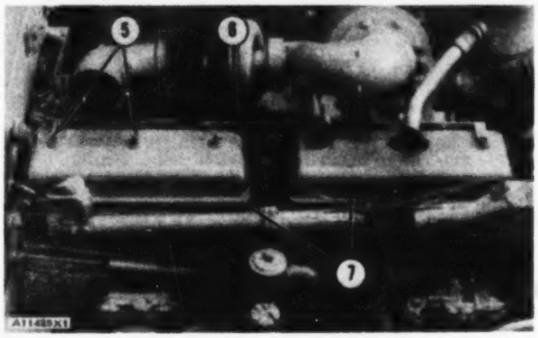
VALVE COVERS

REMOVE VALVE COVERS 11–1107

start by:
a) remove hood

1. Remove oil supply tube (2) for the turbocharger.
2. Remove four bolts (4) and nuts.
3. Remove two bolts (3) and nuts.
4. Fasten a hoist to pipe (1). Remove the pipe. Weight of the pipe is 55 lb. (25 kg).
5. Remove six nuts (5) and washers that hold the valve covers in position.
6. Disconnect the wires from the glow plugs. Move wiring harness (6) until it is clear of the valve covers.
7. Remove the two valve covers (7).

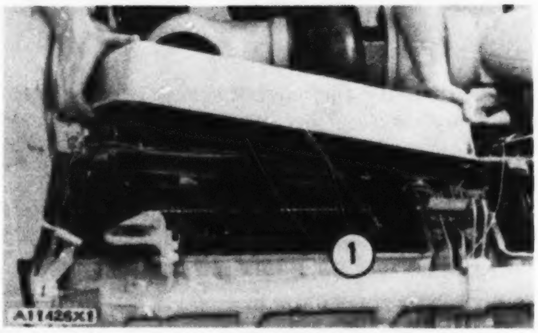


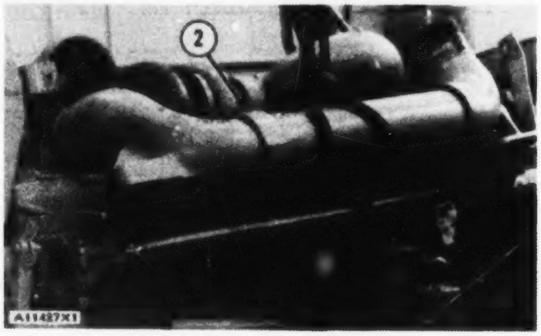


INSTALL VALVE COVERS 12–1107

1. Put 5H2471 Gasket Cement on the top side of the gaskets for the valve covers and surfaces of the covers that make contact with the gaskets.
2. Put the valve covers (1) in position over the studs.
3. Put the wiring harness for the glow plugs in position over the studs. Connect the wires to their respective glow plugs.
4. Install the three nuts and washers that hold each valve cover in position.
5. Fasten a hoist to pipe (2). Put the pipe in position on the water manifold. Install the bolts and nuts that hold it.
6. Install the oil supply tube for the turbocharger.

end by:
a) install hood





PRECOMBUSTION CHAMBERS

REMOVE PRECOMBUSTION CHAMBERS 11–1106

	Tools Needed	A
5F8353	Wrench	1

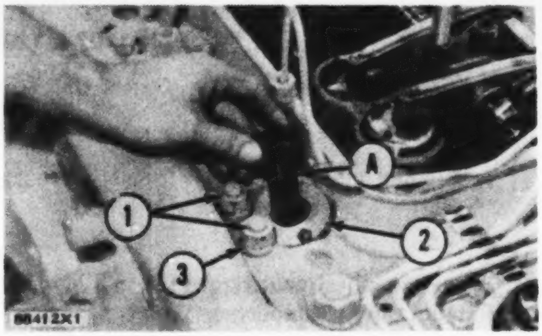
start by:
- a) remove fuel injection valves
- b) remove valve covers
- c) remove glow plugs

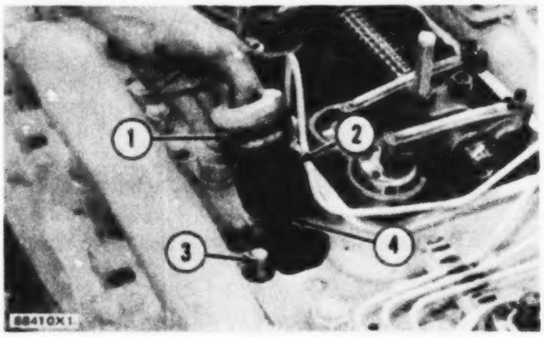
1. Remove the coolant from the engine.
2. Remove nuts (1) and washers (3) from the cylinder head studs.
3. Remove the precombustion chamber (2) with tool (A).

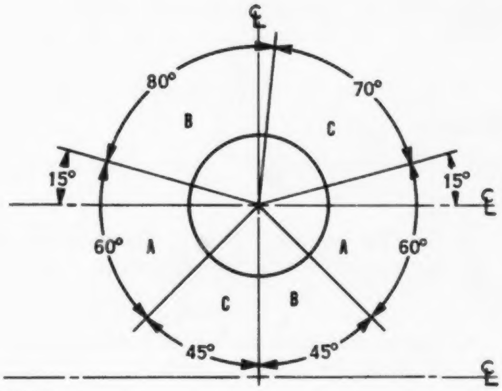
INSTALL PRECOMBUSTION CHAMBERS 12–1106

	Tools Needed	A
5F8353	Wrench	1

1. Install a new O-ring seal (1) on the precombustion chamber (2). Put liquid soap on the seal.
2. Install a new gasket (4) on the chamber. Use a 1P6442 Gasket with "4D" on it.
3. Put 9M3710 Anti-Seize Compound on the threads of the chamber and cylinder head studs (3).
4. Install the precombustion chamber in the cylinder head. Use tool (A) to tighten the chamber to a torque of 200 lb.ft. (27.7 mkg). If the glow plug opening is not in "A RANGE", make a note of the range in which it is found. Remove the chamber and gasket. If the opening was in "B RANGE", install 1P6441 Gasket with "4J" on it. If the opening was in "C RANGE", install 5H2579 Gasket with "4C" on it. Install the chamber in the cylinder head. Tighten the chamber to a torque of 200 lb.ft. (27.7 mkg) with tool (A).
5. Install the washers and nuts on the cylinder head studs. Tighten the nuts to a torque of 60 lb.ft. (8.3 mkg). Tighten the nuts again to a torque of 120 lb.ft. (16.6 mkg).







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6. Fill the engine with coolant to the correct level.

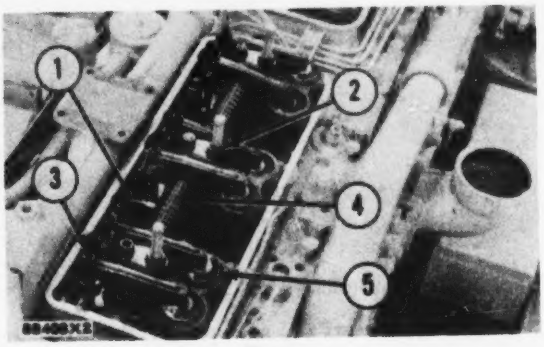
end by:
- a) install fuel injection valves
- b) install valve covers
- c) install glow plugs

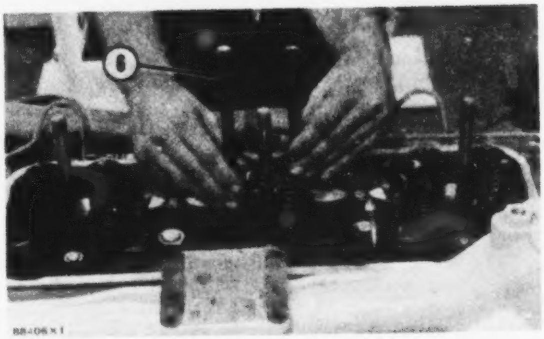
ROCKER SHAFTS AND PUSH RODS

REMOVE ROCKER SHAFTS AND PUSH RODS 11–1102 & 1208

start by:
  a) remove valve covers

1. Disconnect oil line (1) from the rocker shaft.
2. Loosen adjustment screws (3) to have maximum valve clearance.
3. Remove the three nuts (2) that hold each rocker shaft to the cylinder heads.
4. Remove the rocker shafts (4).
5. Remove sleeves (5) from the valve springs.
6. Remove push rods (6) from the valve lifters.

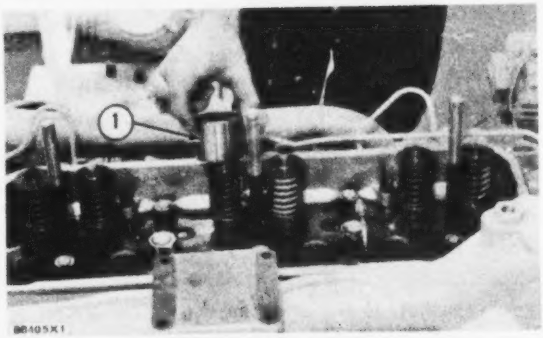


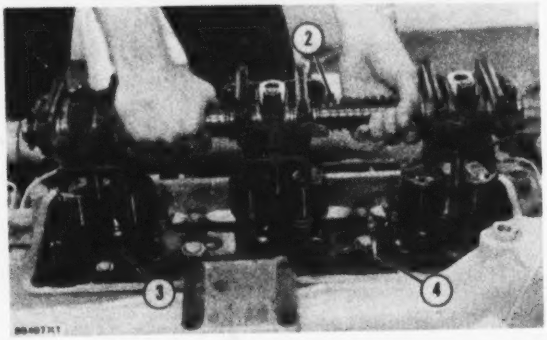


INSTALL ROCKER SHAFTS AND PUSH RODS 12–1102 & 1208

1. Install sleeves (1) on the valve springs.
2. Install push rods (3) in the valve lifters.
3. Put the rocker shafts (2) in position over their studs on the cylinder heads.
4. Install the three nuts that hold each rocker shaft to the cylinder heads.
5. Connect oil line (4) to the rocker shaft.
6. Make an adjustment of valve clearance. The clearance must be .020 in. (0.51 mm) for exhaust and .016 in. (0.41 mm) for intake.

end by:
  a) install valve covers





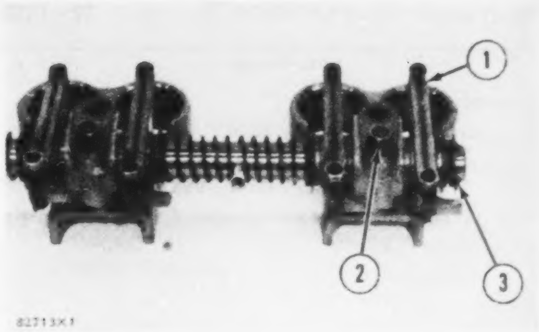
ROCKER SHAFTS

DISASSEMBLE ROCKER SHAFTS 15–1102

Tools Needed		A
1P529	Handle	1
1P466	Drive Plate	1
1P468	Drive Plate	1

start by:
a) remove rocker shafts and push rods

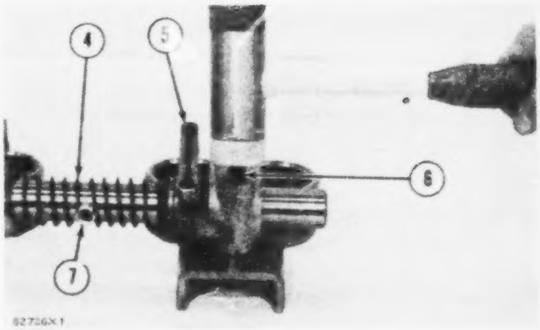
1. Remove cotter pins (3), washers and springs.



2. Remove arm assembly (1) from shaft.

3. Remove the nut (2) from bolt with a groove. Push the bolt (6) down enough to remove the bracket from shaft.

4. Remove arm assembly (5).

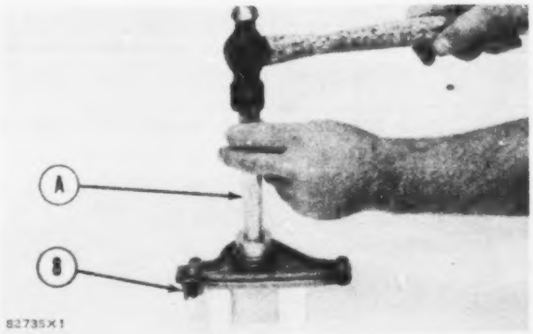


5. Remove fitting (7) for oil line.

6. Remove springs (4) from shaft.

7. Do Steps 1 through 5 for other end of shaft.

8. Use tooling (A) to remove the bearing from rocker arm.



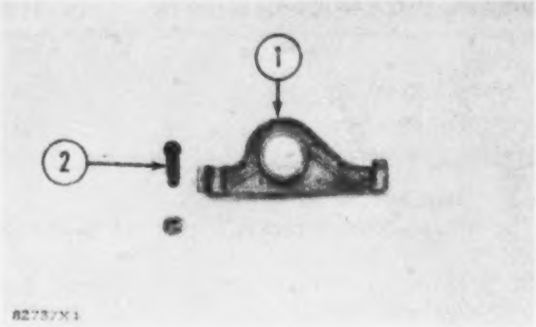
9. Remove nut (8) and adjustment screw from arm.

ROCKER SHAFTS

ASSEMBLE ROCKER SHAFTS 16–1102

Tools Needed		A
1P529	Handle	1
1P466	Drive Plate	1
1P471	Drive Plate	1

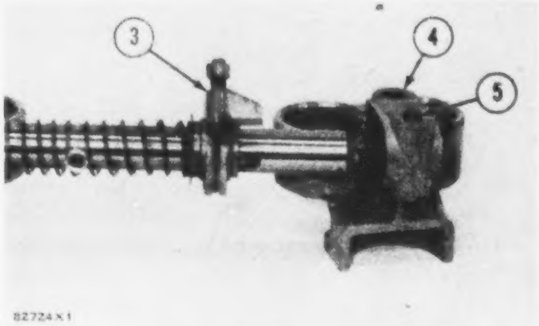
1. Install adjustment screws (2) and nuts on arms (1).



2. Use tooling (A) to install bearing in arms. Install bearings with hole in bearing in alignment with oil hole in arm.

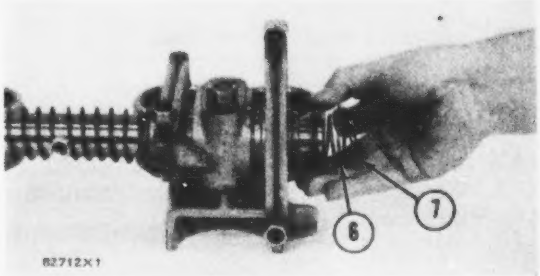
3. Install springs and fittings on shaft.

4. Install rocker arm (3) and bracket (4) on shaft.



5. Push bolt (5) with a groove up enough to hold bracket (4) on shaft. Install nut. Tighten nut to 30 ± 5 lb.ft. (4.1 ± 0.7 mkg).

6. Install the rocker arm, washers (7), spring (6) and cotter pin.

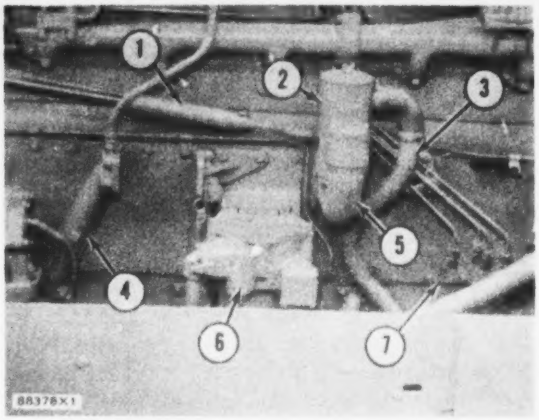


end by:
a) install rocker shafts and push rods

VALVE LIFTERS

REMOVE VALVE LIFTERS 11–1209

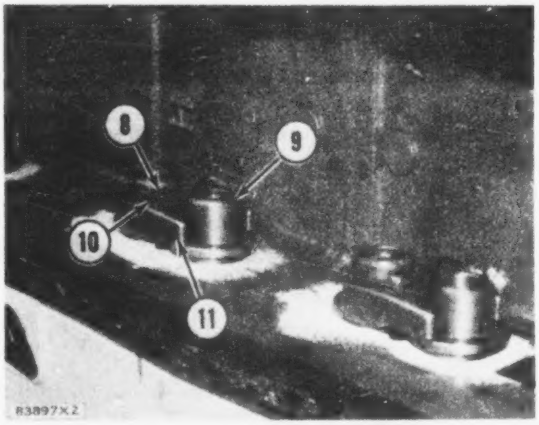
start by:
- a) remove oil filter base
- b) remove accessory drive
- c) remove rocker shafts and push rods



1. Remove breather (2), oil filler (5), and breather tube (3).

2. Remove oil filter (6) for the transmission.

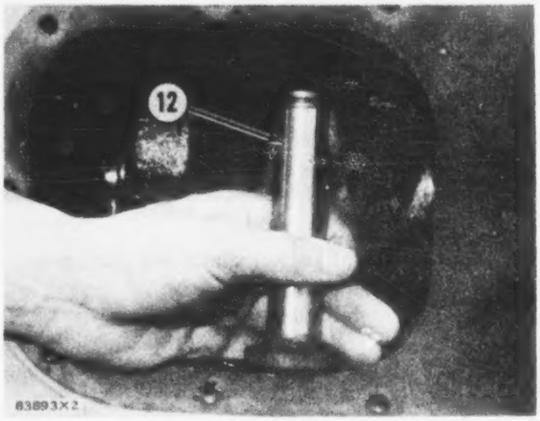
3. Disconnect linkage (1) for governor control.



4. Remove the nuts that hold support (4) for the oil filter to the cylinder block. Slide the support away from the cylinder block.

5. Remove side cover (7) for the cylinder block.

6. Remove two inspection covers from the right side of the cylinder block.



7. Remove bolts (8) and locks (10) that hold yokes (11) to the cylinder block. Remove the yokes.

8. Remove valve guides (9) from the valve lifters.

9. Remove valve lifter (12) from the camshaft through the openings for the inspection covers.

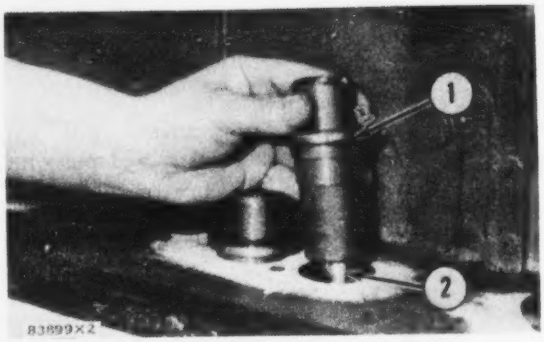
VALVE LIFTERS

INSTALL VALVE LIFTERS 12–1209

1. Put clean engine oil on the valve lifters.

2. Install valve lifters (2) on the camshaft through the opening for the inspection cover.

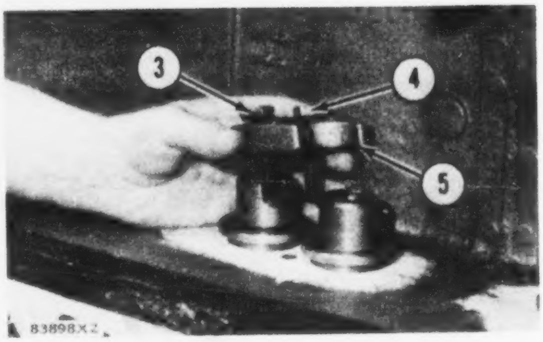
3. Install valve guides (1) over the valve lifters through opening for the side cover.



4. Put yokes (5) in position over the guides. Install the locks (3) and bolts (4) that hold the yokes. Tighten the bolts to a torque of 24 ± 5 lb.ft. (3.3 ± 0.7 mkg).

5. Install inspection covers (8) and (9).

6. Install the side cover for the cylinder block.

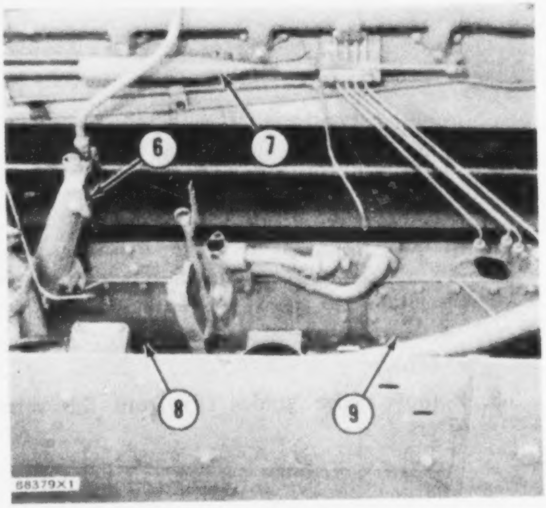


7. Slide support (6) for the oil filter toward the cylinder block and install the nuts that hold it.

8. Connect linkage (7) for governor control to its lever on the side cover.

9. Install the oil filter for the transmission on the side cover.

10. Install the breather, oil filler, and breather tube on the side cover.

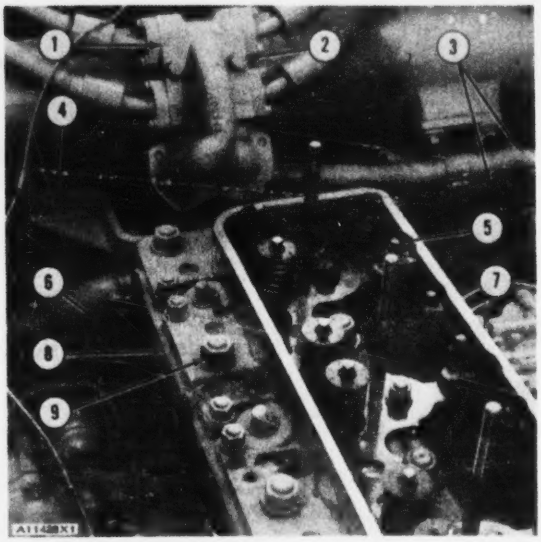


end by:
- a) install rocker shafts and push rods
- b) install accessory drive
- c) install oil filter base

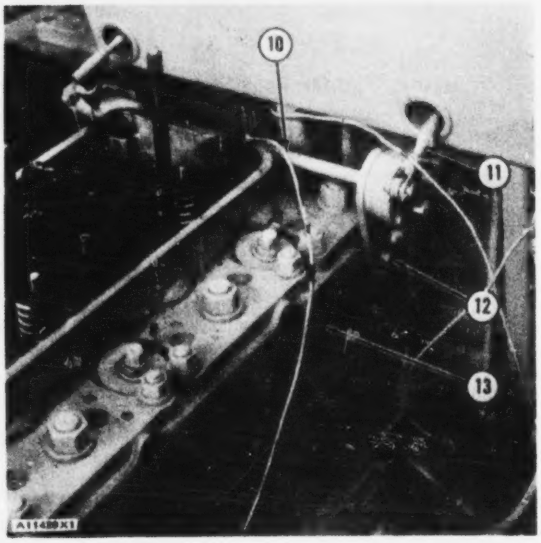
CYLINDER HEADS

REMOVE CYLINDER HEADS 11–1101

start by:
- a) remove inlet manifold
- b) remove exhaust manifold
- c) remove water manifold
- d) remove fuel injection lines
- e) remove rocker shafts and push rods



1. Remove the bolts that hold bracket (4) to the cylinder head.
2. Disconnect two oil lines (3) from oil manifold (1) for the bulldozer tilt cylinder. Remove bolts (2) and move manifold clear of the cylinder head.
3. Disconnect vent line (6) from the cylinder head.
4. Remove bolts (5) that hold the valve cover base (7) to the cylinder head. Remove the valve cover base.
5. Remove nuts (9) and washers that hold the cylinder head to the cylinder block.
6. Install two 3/8"–16 NC forged eyebolts in the cylinder head. Fasten a hoist to the cylinder head. Remove the front cylinder head (8). Weight of the cylinder head is 230 lb. (104 kg).
7. Disconnect linkages (11) from the governor shaft (10). Remove bolts (12). Remove the shaft.
8. Do Steps 4 through 6 and remove the rear cylinder head (13). Weight of the rear cylinder head is 230 lb. (104 kg).



CYLINDER HEADS

INSTALL CYLINDER HEADS 12–1101

1. Clean the gasket surfaces of the cylinder heads and block.

2. Install new gaskets. Install new ferrules and seals. Install the ferrules, with the ends that have a taper (rolled ends) toward the cylinder head.

3. Install two 3/8"–16 NC forged eyebolts in the cylinder heads. Fasten a hoist to the eyebolts. Install the cylinder heads (1) slowly over their studs on the cylinder block.

4. Put 4S9416 Anti-Seize Compound on the threads of the nuts for the cylinder head studs. Install the washers and nuts. Tighten the nuts in the following step sequence:

   Step 1: Tighten the 5/8" nuts in number sequence to a torque of 60 lb.ft. (8.3 mkg).

   Step 2: Tighten the 7/8" nuts in letter sequence to a torque of 150 lb.ft. (20.7 mkg).

   Step 3: Tighten the 7/8" nuts again in letter sequence to a torque of 300 lb.ft. (41.5 mkg).

   Step 4: Tighten the 5/8" nuts again in number sequence to a torque of 120 lb.ft. (16.6 mkg).

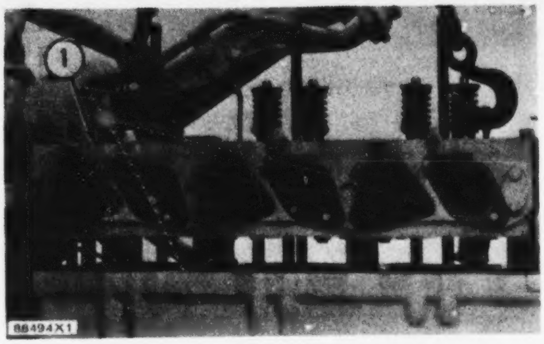
   Step 5: Tighten the 7/8" nuts again in letter sequence by hand to a torque of 300 lb.ft. (41.5 mkg).

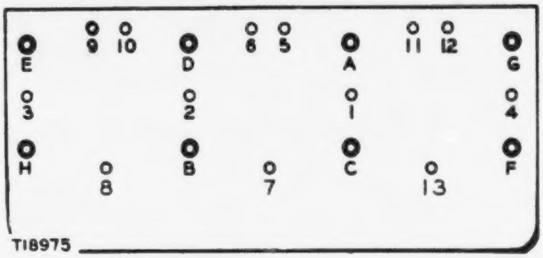
   Step 6: Tighten the 5/8" nuts again in number sequence by hand to a torque of 120 lb.ft. (16.6 mkg).

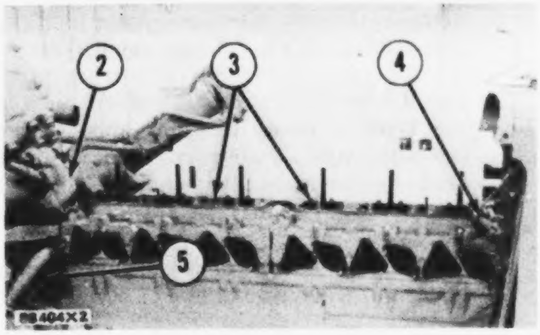
5. Install the valve cover bases (3) on the cylinder heads.

6. Install the two bolts that connect the bracket on the rear cylinder head to the dash.

7. Put governor control shaft (4) in position on the rear cylinder head. Install the bolts that hold it. Connect the linkages to the shaft.







8. Put oil manifold (2) in position on the bulldozer tilt cylinder. Install the bolts that hold it. Connect two oil lines to the oil manifold.

9. Connect vent line (5) to the front cylinder head.

end by:

- a) install rocker shafts and push rods
- b) install fuel injection lines
- c) install water manifold
- d) install exhaust manifold
- e) install inlet manifold

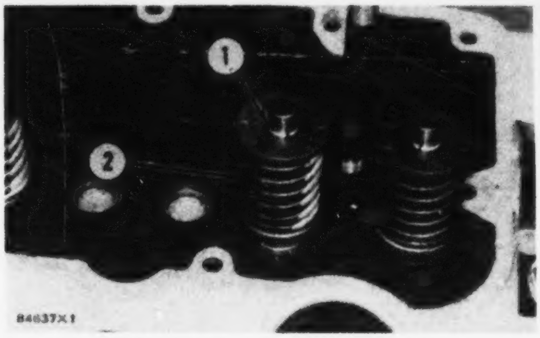
VALVES

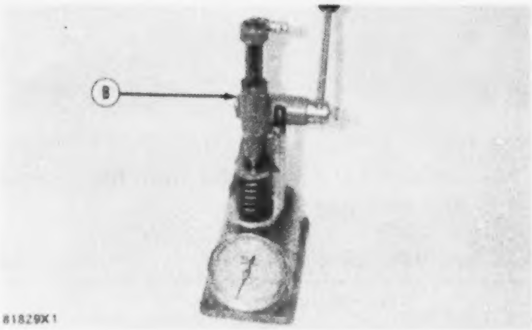
REMOVE VALVES 11–1105

Tools Needed		A	B
5S1330	Valve Spring Compressor	1	
8S2263	Valve Spring Tester		1

start by:
- a) remove cylinder heads
- b) remove precombustion chambers

1. Put compression on valve spring (2) with tool (A) and remove locks (1).
2. Remove tool (A) retainer, springs, valve and rotator. Remove the spacer from the valve guide. If old valves can be used again, put identification on the valves as to their location in the cylinder head.
3. Check spring force with tool (B). Spring force for the outer spring is 65 ± 3 lb. (29.5 ± 1.4 kg) when the length of the spring under test force is 2.219 in. (56.36 mm). Spring force for the inner spring is 20 ± 1 lb. (9.1 ± 0.5 kg) when the length of the spring under test force is 1.791 in. (45.49 mm).
4. Do Steps 1 through 3 to remove the other valves.





INSTALL VALVES 12–1105

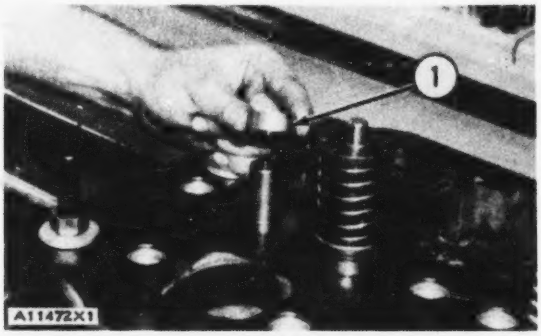
Tools Needed		A
5S1330	Valve Spring Compressor	1

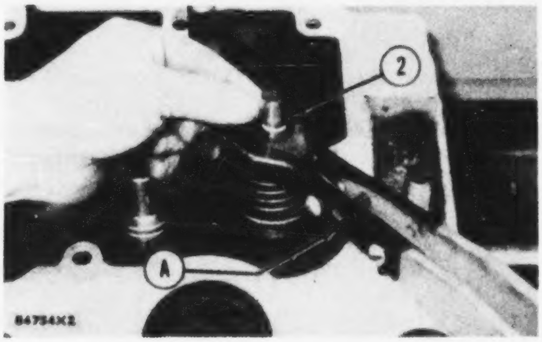
1. Put clean oil on the valve stem. Put the spacer (1) on the valve guide. Install valve, rotator, springs and the retainer.
2. Put pressure on the valve springs with tool (A). Install locks (2) with the thick end of the lock away from the top of the cylinder head.

⚠ WARNING: The locks can be thrown from the valve when the valve spring compressor is released. Make sure the locks are in the correct position on the valve.

3. Remove valve spring compressor and hit the valve with a soft hammer to be sure the locks are in the correct position on the valve.
4. Do Steps 1 through 3 to install the other valves.

end by:
- a) install precombustion chambers
- b) install cylinder heads



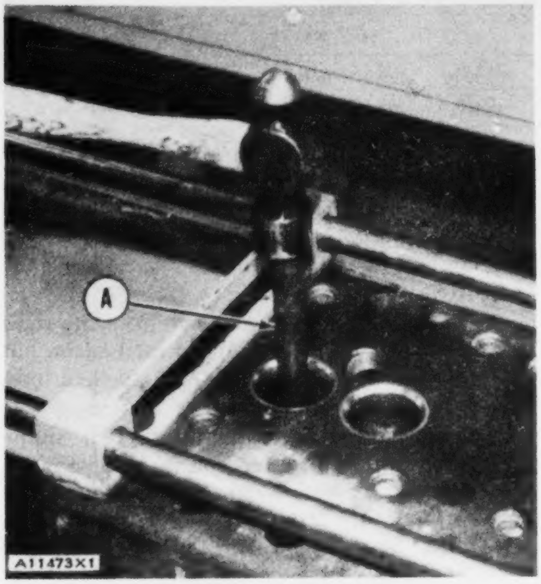


VALVE GUIDES

REMOVE VALVE GUIDES 11–1104

Tools Needed		A
4H446	Guide Driver	1

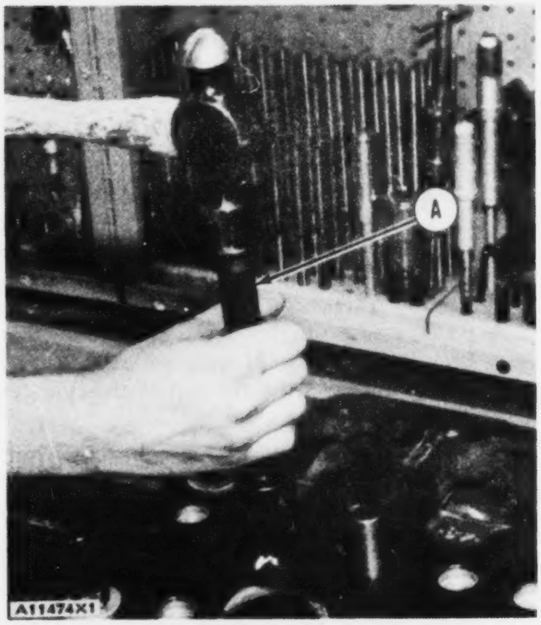
start by:
a) remove valves



1. Remove six valve guides from the cylinder head with tool (A).

INSTALL VALVE GUIDES 12–1104

Tools Needed		A
4H446	Guide Driver	1
5P1727	Bushing	1



1. Put clean SAE 30 oil on the outside diameter of the valve guides.

2. Install the six valve guides with tooling (A).

3. The inside diameter of the valve guides after installation must be a minimum of .500 in. (12.7 mm).

end by:
a) install valves

VALVE SEAT INSERTS AND WATER DIRECTORS

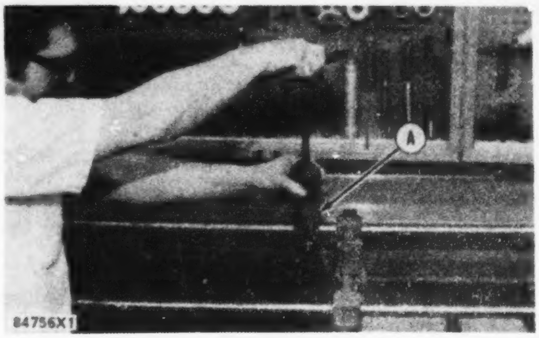
REMOVE AND INSTALL VALVE SEAT INSERTS 10–1103

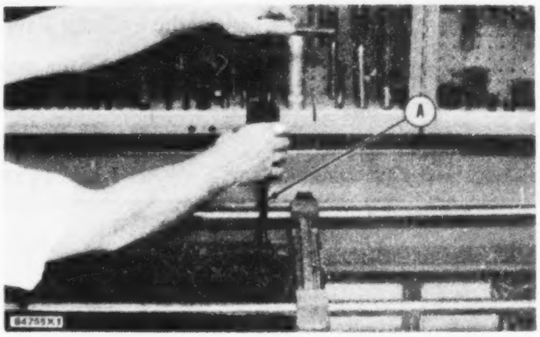
	Tools Needed	A
9S3080	Valve Seat Insert Group	1

start by:
a) remove valves

1. Remove valve seat insert with tool group (A).
2. Clean and remove burrs from the valve seat bore.
3. Install the new valve seat insert with tool group (A). Do not increase diameter of extractor in valve seat insert when installing insert in cylinder head.
4. Grind valve seat insert according to specifications given in SPECIFICATIONS SECTION.

end by:
a) install valves



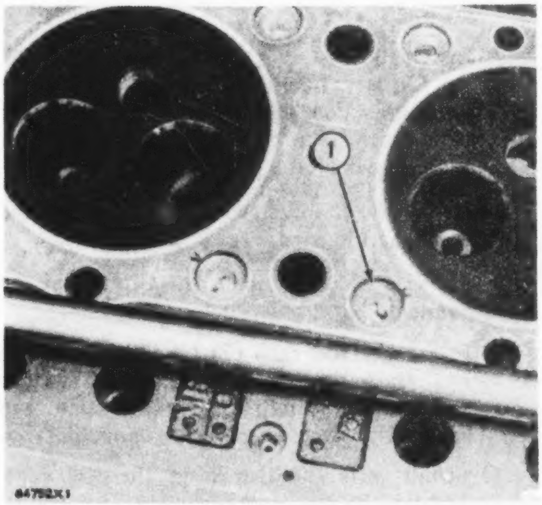


REMOVE AND INSTALL WATER DIRECTORS 10–1115

start by:
a) remove cylinder heads

1. Remove old water directors (1) from the cylinder head.
2. Clean the cylinder block.
3. Install new water directors in the cylinder head. Install the directors so the hole in directors is in alignment with the "V" mark on cylinder head.

end by:
a) install cylinder heads

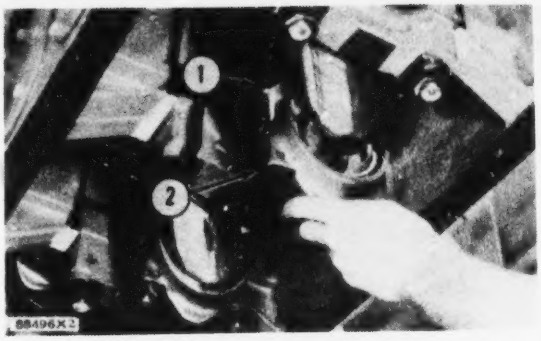


PISTONS

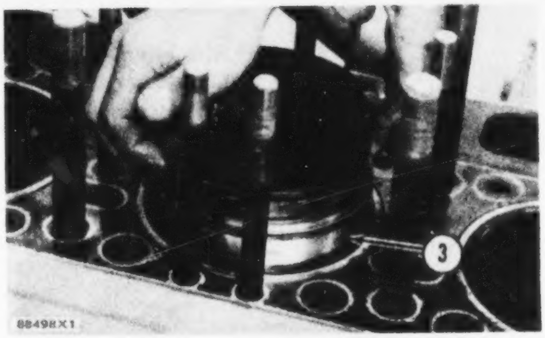
REMOVE PISTONS 11–1214

start by:
- a) remove cylinder heads
- b) remove oil pans

1. Turn the crankshaft until the piston to be removed is at its top center position.
2. Remove the nuts and rod cap (2) from the connecting rod (1).



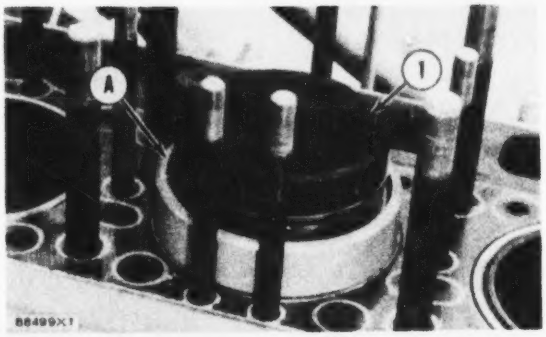
3. Remove the carbon from inside at the top of the cylinder liner.
4. Push the connecting rod and piston up until the piston rings are out of the cylinder liner.
5. Remove piston (3) and its connecting rod from the cylinder liner. Weight is 40 lb. (20 kg).



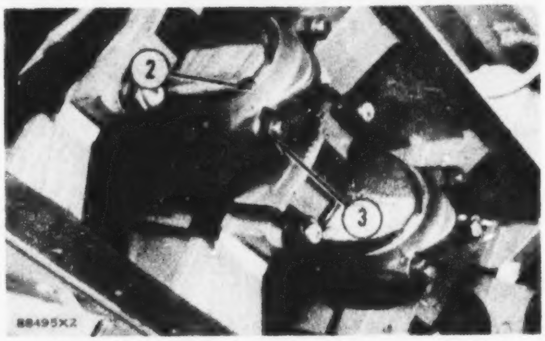
INSTALL PISTONS 12–1214

	Tools Needed	A
2B8184	Piston Ring Compressor	1

1. Put clean engine oil on the crankshaft bearing journals, in the cylinder liners, on the piston rings, and on the connecting rod bearings.
2. Install tool (A) on the cylinder liner. Install the piston (1) and connecting rod in its cylinder liner. Make sure the "V" mark on the piston is in alignment with the "V" mark on the cylinder block.



3. Lower the connecting rod carefully over the crankshaft journal.
4. Put clean engine oil on the threads of the connecting rod bolts.
5. Install the rod caps (2) on the connecting rod. Make sure the number on the rod cap and the connecting rod are the same, and are on the same side of the connecting rod.
6. Install nuts (3) that hold the rod caps. Tighten the nuts to a torque of 75 ± 5 lb.ft. (10.4 ± 0.7 mkg). Put a mark on the nuts and the cap. Tighten the nuts an extra 60° ± 5° from the mark.



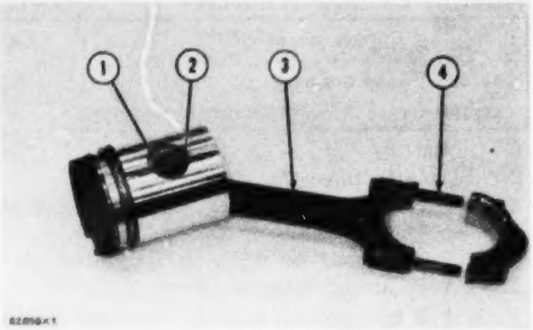
end by:
- a) install oil pans
- b) install cylinder heads

PISTONS

DISASSEMBLE PISTONS 15–1214

Tools Needed		A	B
1P529	Handle	1	
1P485	Drive Plate	1	
1P488	Drive Plate	1	
7B7974	Ring Expander		1

start by:
a) remove pistons



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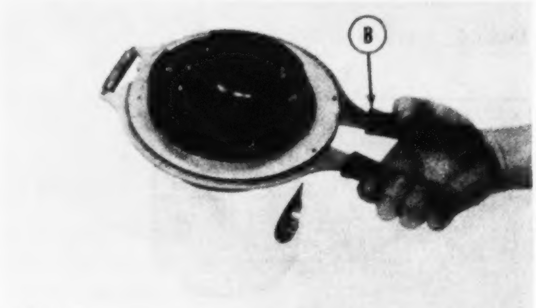
1. Remove retainers (2) that hold pin.

2. Remove the pin (1) and rod (3).

3. Remove bolts (4) from rod.

4. Use tooling (A) to remove bearings from connecting rods.



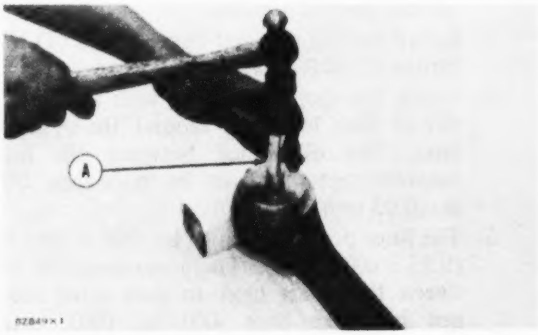
82858X1

5. Use tool (B) to remove rings from pistons.

ASSEMBLE PISTONS 16–1214

Tools Needed		A	B
1P529	Handle	1	
1P485	Drive Plate	1	
1P488	Drive Plate	1	
7B7974	Ring Expander		1

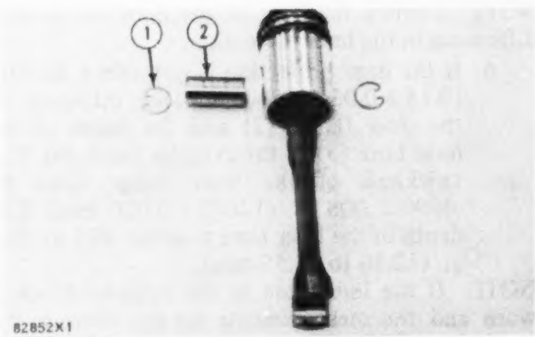
1. Use tooling (A) to install bearings in connecting rod. Install bearing with oil hole in bearing in alignment with oil passage in connecting rod. Bore in bearing must be honed to correct size for piston pin (2). See SPECIFICATIONS SECTION.



82849X1

2. Use tool (B) to install rings on piston. Install the oil ring on bottom groove. Install middle ring with "UP-2" toward the top of piston. Install top ring with "UP-1" toward the top of piston. Turn rings so gap of rings are 120° from each other.

3. Put clean engine oil on pin. Install the connecting rod in piston. Install pin (2) and retainers (1). Be sure retainers are in their grooves. Install piston so the "V" mark on piston is on opposite side of number on connecting rod.



82852X1

end by:
a) install pistons

CYLINDER LINERS

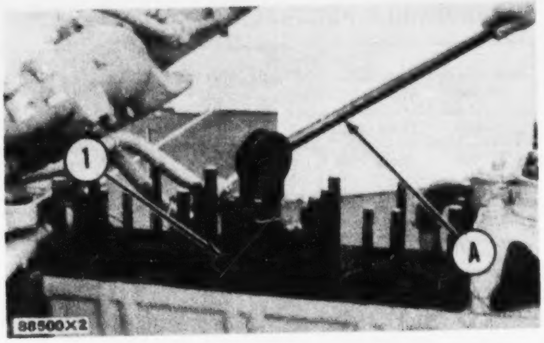
REMOVE CYLINDER LINERS 11–1216

Tools Needed		A
1P2399	Puller Group	1
1P2397	Plate	1

start by:

a) remove pistons

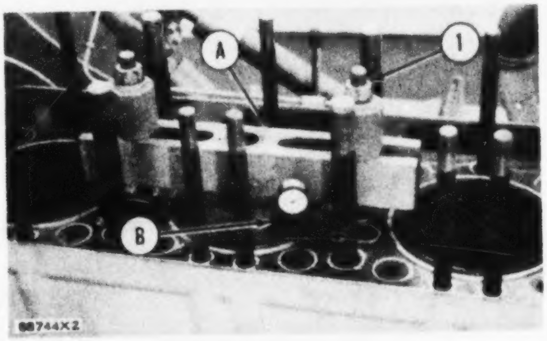
1. Remove the coolant from the cylinder block.
2. Put a cover on the crankshaft journals to keep foreign material away.
3. Pull the cylinder liner (1) from the cylinder block with tooling (A). Remove tooling (A) and the cylinder liner.



INSTALL CYLINDER LINERS 12–1216

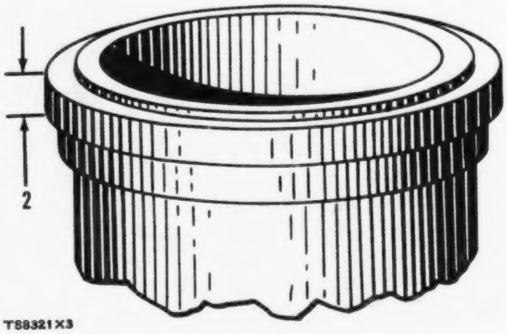
Tools Needed		A	B	C
1P2397	Plate	1		
8B7548	Puller Assembly	1		
9S9076	Spacer	2		
1P5510	Liner Projection Tool Group		1	
2P8260	Liner Installer Group			1

1. Clean the cylinder liners and the bores in the cylinder block.
2. Install the liners in the cylinder block without the seals and bands.
3. Install tooling (A) and tighten nuts (1) to a torque of 50 lb.ft. (6.9 mkg).
4. Check the liner projection with tool group (B) at four locations around the cylinder liner. The difference between the four measurements must not be more than .001 in. (0.03 mm).
5. The liner projection must be .006 ± .002 in. (0.15 ± 0.05 mm). The measurements between the liners next to each other must not be more than .001 in. (0.03 mm) difference.



NOTE: Turning the liner in the bore can make a difference in the liner projection.

6. If the liner projection is not .006 ± .002 in. (0.15 ± 0.05 mm) check the thickness of the liner flange (2) and the depth of the liner bore (3) in the cylinder block (4). The thickness of the liner flange must be .4990 ± .008 in. (12675 ± 0.020 mm). The depth of the liner bore must be .492 to .494 in. (12.50 to 12.55 mm).



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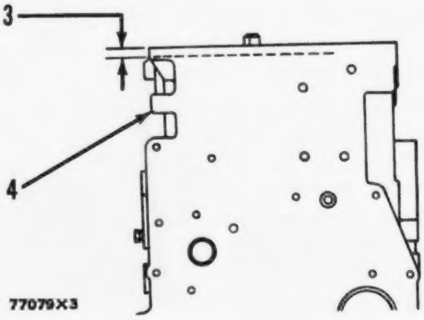
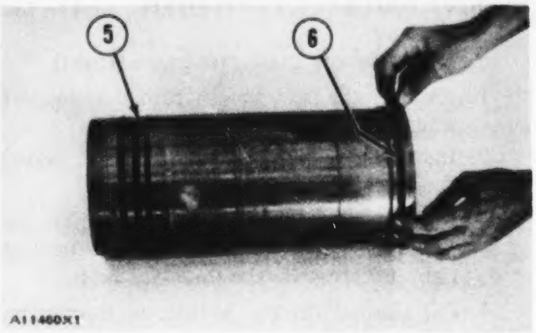


NOTE: If the liner bore in the cylinder block is worn and the measurements are not correct, the liner bore can be corrected with a counterboring tool. See SPECIAL INSTRUCTION FORM FM055228-01.

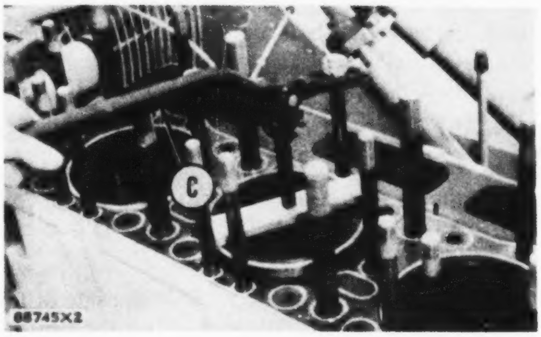
CYLINDER LINERS

7. Put a mark on the cylinder liners and the cylinder block so the liners can be installed in the same position in the cylinder block.

8. Install new seals (5) on the cylinder liners. Put liquid soap on the seals and in the bores in the cylinder block.



9. Put clean diesel fuel on band (6) and install it on the liner as shown. Put clean SAE 30 oil on the liner and install it immediately in the cylinder block with tool group (C).



CAUTION: The liners must be installed in the cylinder block immediately after band (6) is installed. Make sure the marks on the liners and the cylinder block are in alignment when installing the cylinder liners.

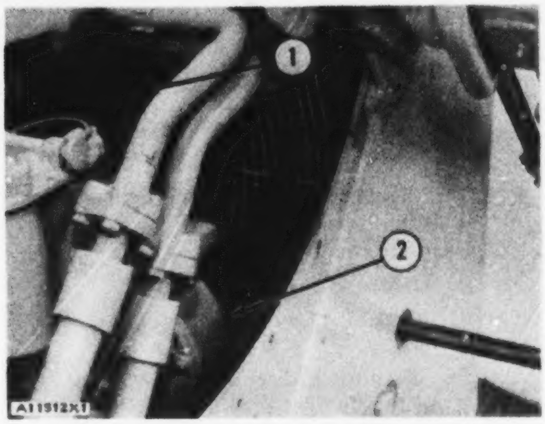
FAN BELT TIGHTENER

REMOVE FAN BELT TIGHTENER 11–1358

start by:

a) remove crankcase guard (front)

1. Remove the side panels from the engine (if so equipped).
2. Install a bar through the hole in the side of the radiator guard as shown.
3. Put pressure on top of the fan belt tightener. With pressure on the fan belt tightener, remove the three vee belts.
4. Put the bar on the bottom of the fan belt tightener. Put pressure on the fan belt tightener and disconnect spring (1).
5. Remove the bolt and washers that hold the fan belt tightener to the timing gear cover. Remove fan belt tightener (2).

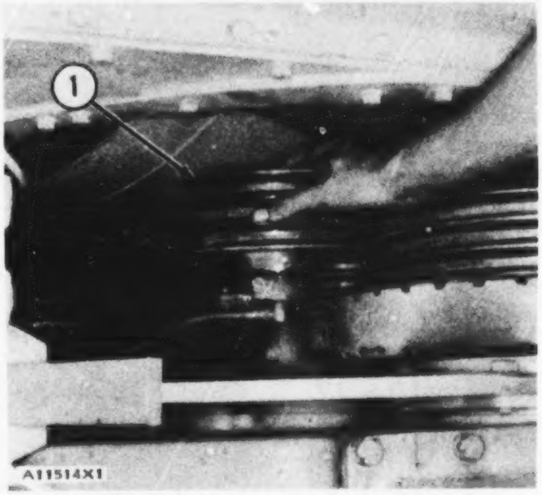


INSTALL FAN BELT TIGHTENER 12–1358

1. Put the fan belt tightener (1) in position on the timing gear cover. Install the bolt and washer that hold the fan belt tightener in position.
2. Put a bar through the hole in the side of the radiator guard. Put pressure on the bottom of the fan belt tightener and connect the spring to the arm assembly of the fan belt tightener. Put pressure on top of the fan belt tightener and install the three vee belts.
3. Install side panels on the engine (if so equipped).

end by:

a) install crankcase guard (front)

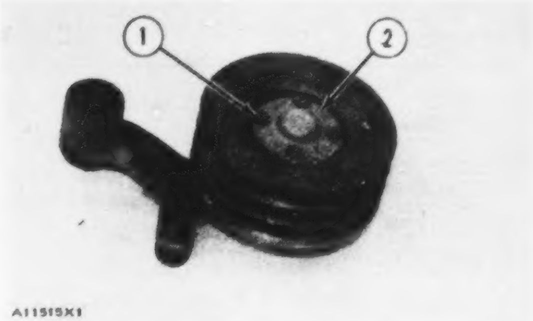


FAN BELT TIGHTENER

DISASSEMBLE FAN BELT TIGHTENER 15–1358

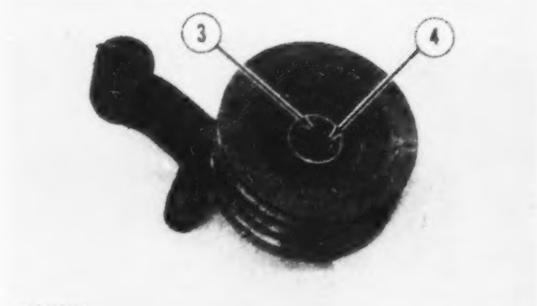
Tools Needed		A	B
8B7548	Puller Assembly	1	
5F7343	Bearing Pulling Attachment	1	
5F7342	Adapter	1	
8B7550	Leg	2	
8H684	Ratchet Box Wrench	1	
1P529	Handle		1
1P479	Drive Plate		1
1P462	Drive Plate		1

start by:
  a) remove fan belt tightener



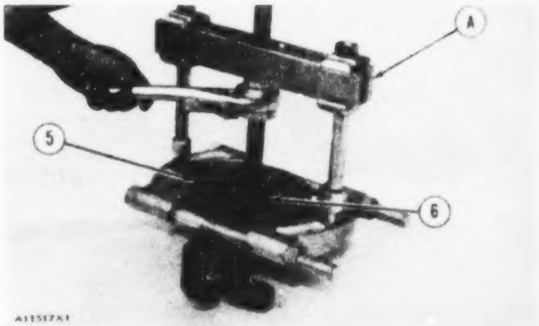
A11515X1

1. Remove bolts (1) and cover (2).



A11516X1

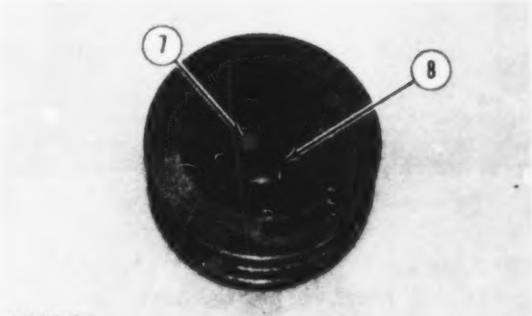
2. Remove bolt (3) and washers (4).



A11517X1

3. Install tooling (A) and remove pulley (5).

4. Hit around the inner bore of the spacer lightly with a soft hammer until there is enough gap between the bearing and spacer to remove the bearing. Remove bearing (6) and the spacer.



A11518X1

5. Remove ring (7) from the groove in the pulley.

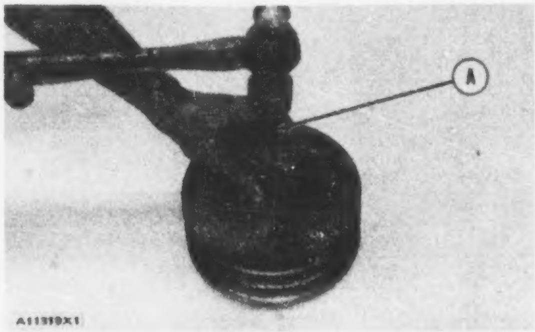
6. Use tooling (B) to remove the bearing (8) and the lip-type seal from the pulley.

FAN BELT TIGHTENER

ASSEMBLE FAN BELT TIGHTENER 16-1358

Tools Needed		A	B
1P529	Handle	1	1
1P479	Drive Plate	1	
1P462	Drive Plate	1	
1P480	Drive Plate		1
1P467	Drive Plate		1

1. Install ring (9) in the groove of the pulley.

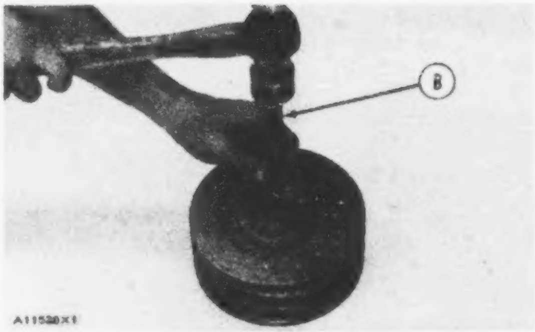


A11519X1

2. Install bearing (7) against the ring with tooling (A).

3. Install spacer (11) in the opposite end of the pulley.

4. Install bearing (10) with tooling (A) until it is against the spacer.



A11520X1

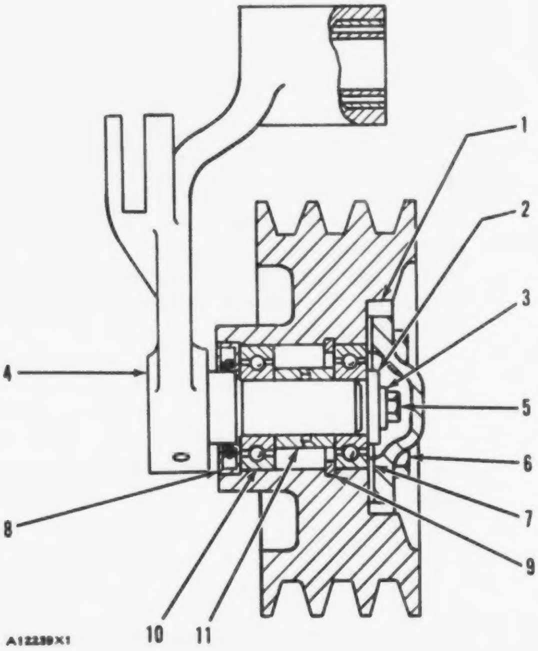
5. Install the lip-type seal (8) in the pulley with tooling (B). Make sure the lip of the seal is now toward the bearings. Put 1P808 General Purpose Lubricant on the lip of the seal.

6. Put the pulley over arm assembly (4).

7. Install bolt (5), washer (3) and washer (2).

8. Install cover (1) and bolts (6).

end by:
  a) install fan belt tightener



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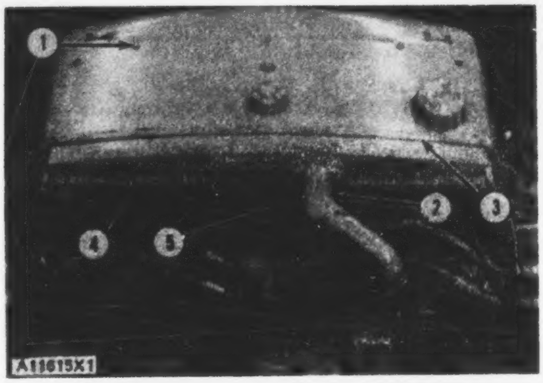
RADIATOR

REMOVE RADIATOR 11–1353

start by:
- a) remove hood
- b) remove crankcase guard (front)



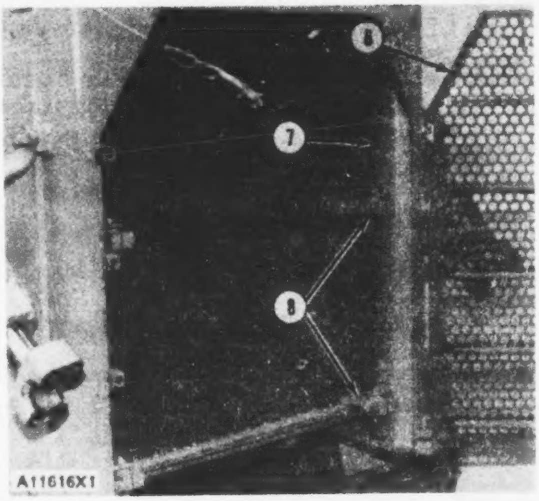
1. Drain the coolant from the cooling system.

2. Disconnect gauge line (5) from the top tank.

3. Disconnect inlet elbow (2) from the top tank.

4. Remove bolts (1) and cover (3).

5. Remove bolts (4) that hold the top tank to the rear shield.

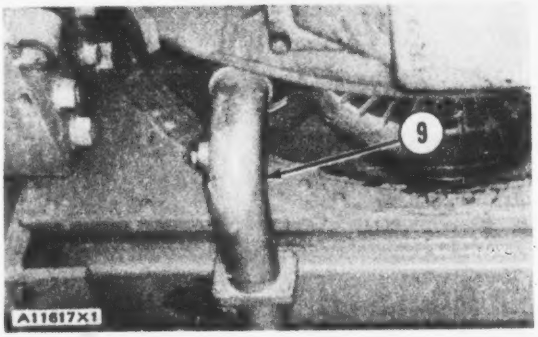


6. Remove the two bolts that hold the grille plate (6) in position. Open the grille plate as shown.

7. Remove four brackets (8) that hold the radiator to the side guards.

8. Remove two baffles (7) from each side of the radiator.

9. Disconnect outlet elbow (9) from the bottom tank.



10. Install two 3/8"–16 NC forged eyebolts in the sides of the radiator. Fasten a hoist to the radiator as shown.

CAUTION: Do not put pressure on the sides of the radiator.

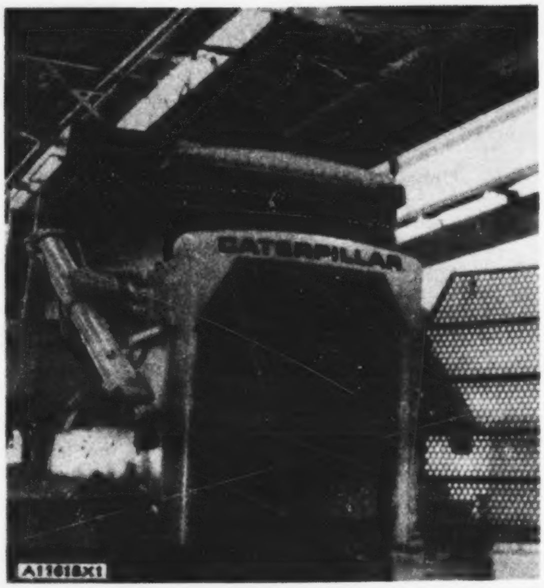
11. Remove the radiator from the radiator guard. Weight of the radiator is 650 lb. (295 kg).

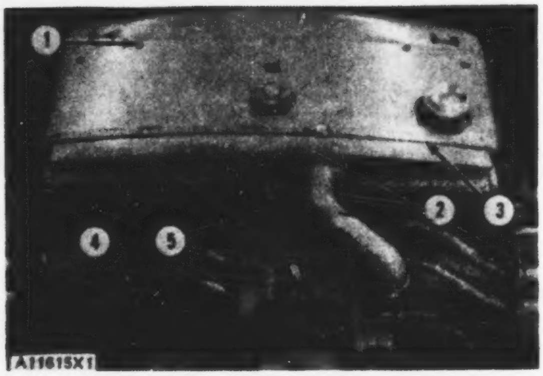
RADIATOR

INSTALL RADIATOR 12–1353

1. Fasten a hoist to the radiator.
2. Put the radiator in position in the radiator guard.
3. Install the two baffles on each side of the radiator guard.
4. Install the four brackets that hold the radiator to the side guards.
5. Put the front grille plate in position and install the two bolts that hold it.
6. Connect the outlet elbow to the bottom tank.
7. Install bolts (4) that hold the top tank to the rear shield.
8. Put cover (3) in position on the side guards and install bolts (1) that hold it.
9. Connect inlet tube (2) to the top tank.
10. Connect gauge line (5) to the top tank.
11. Fill the cooling system with coolant to the correct level. See LUBRICATION AND MAINTENANCE GUIDE.

end by:
  a) install crankcase guard (front)
  b) install hood





RADIATOR AND GUARD

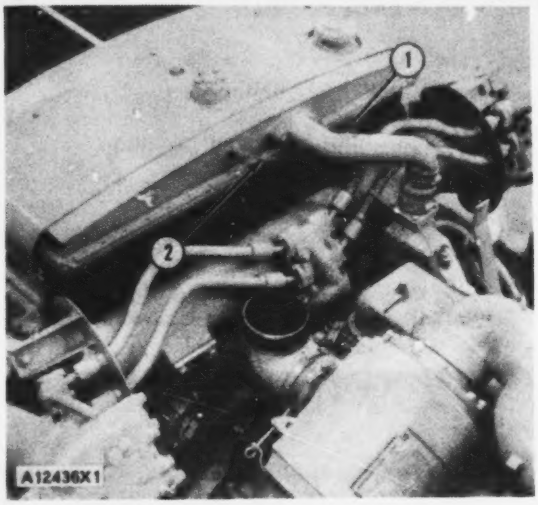
REMOVE RADIATOR AND GUARD 11–1381

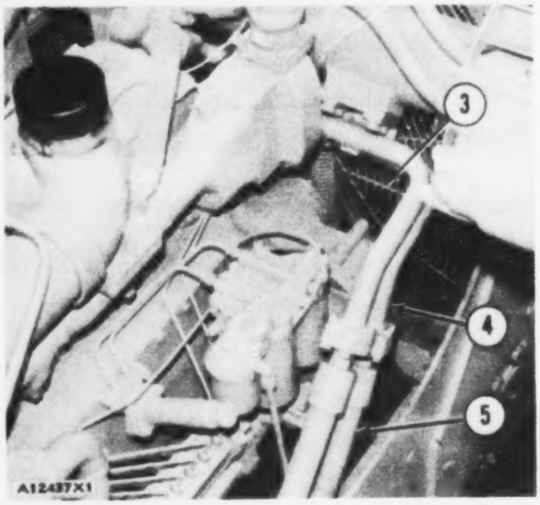
start by:
- a) remove hood
- b) remove crankcase guards (front)

1. Drain the coolant from the radiator.
2. Disconnect gauge line (2) for the water pressure from the radiator.
3. Disconnect inlet elbow (1) from the radiator.
4. Remove the clip that holds the wires for the alternator to the guard for the radiator.
5. Loosen the clamps for the hose between the outlet elbow for the radiator and the water pump elbow. Slide the hose down on the outlet elbow.
6. Disconnect outlet lines (5) from tube (4).
7. Remove the bolts that hold the fan guard (3) to the radiator. Move the fan guard to the side until the bolts that hold the fan to the fan drive can be removed. Remove the bolts that hold the fan in position. Put the fan against the radiator.

CAUTION: Do not cause damage to the radiator when the fan is put against it.

8. Fasten a hoist to the radiator and guard. Remove the bolts and washers that hold the guard to the frame. Remove the radiator and guard as a unit. Weight of the unit is 3600 lb. (1633 kg).

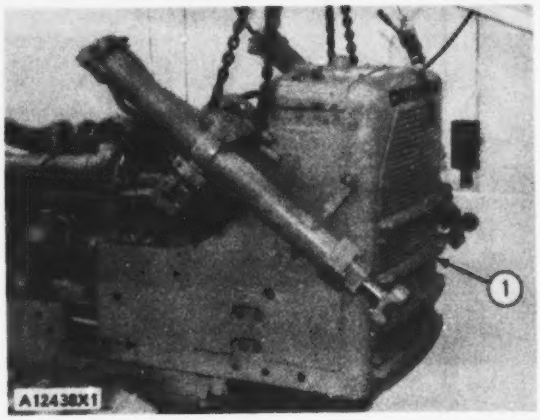




INSTALL RADIATOR AND GUARD 12–1381

1. Fasten a hoist to the radiator and guard (1). Put the unit in position on the frame. Install the bolts and washers that hold it.
2. Put the fan in position on the fan drive. Install the bolts that hold it.
3. Connect the hydraulic lines to the tubes for the cylinders.
4. Install the elbow between the water pump and the radiator.
5. Install the clip that holds the wires for the alternator.
6. Connect the inlet elbow to the radiator.
7. Connect the water pressure line to the radiator.
8. Fill the radiator with coolant to the correct level. See LUBRICATION AND MAINTENANCE GUIDE.

end by:
- a) install crankcase guards (front)
- b) install hood

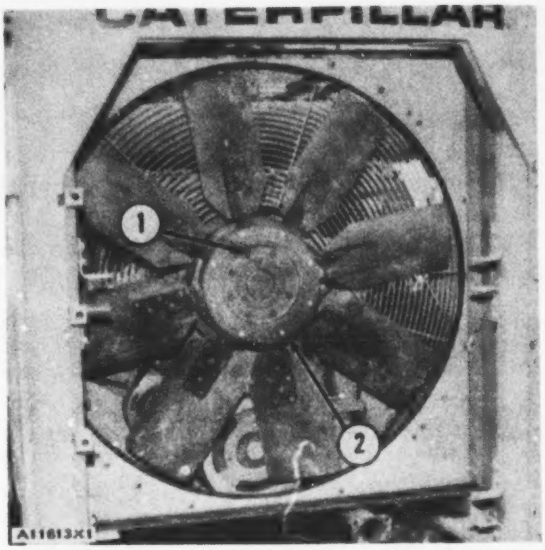


FAN ASSEMBLY

REMOVE FAN ASSEMBLY 11–1356

start by:
a) remove radiator

1. Fasten a hoist to the fan assembly.

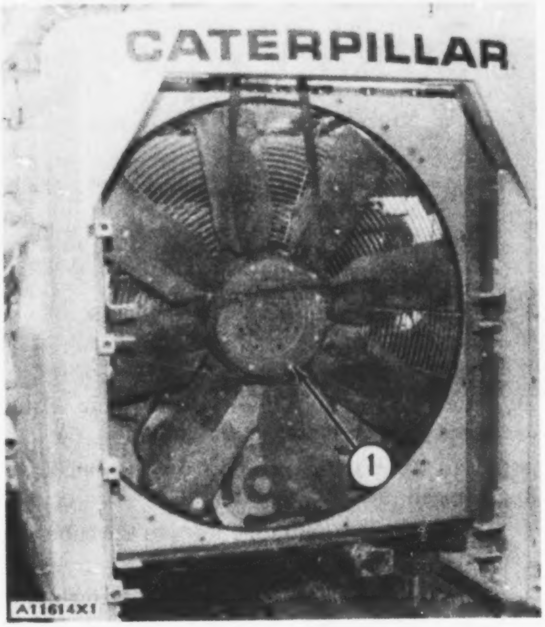


2. Remove bolts (1) that hold the fan assembly to the fan drive.

3. Remove fan assembly (2) from the fan drive through the radiator shield. Weight of the fan assembly is 92 lb. (42 kg).

INSTALL FAN ASSEMBLY 12–1356

1. Fasten a hoist to the fan assembly.



2. Put fan assembly (1) in position on the fan drive.

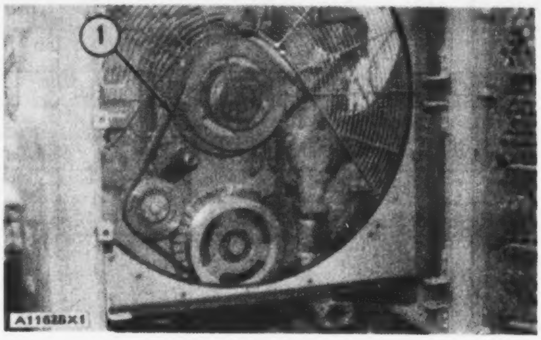
3. Install the bolts that hold the fan assembly in position.

end by:
a) install radiator

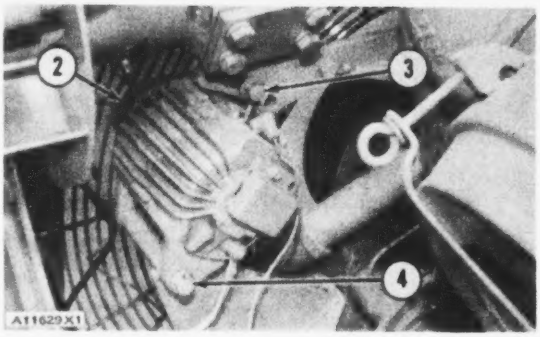
FAN DRIVE

REMOVE FAN DRIVE 11–1359

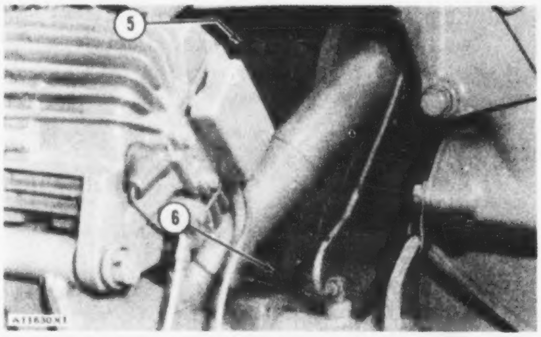
start by:
a) remove fan assembly



1. Remove the three vee belts (1) from the fan drive. See REMOVE FAN BELT TIGHTENER.

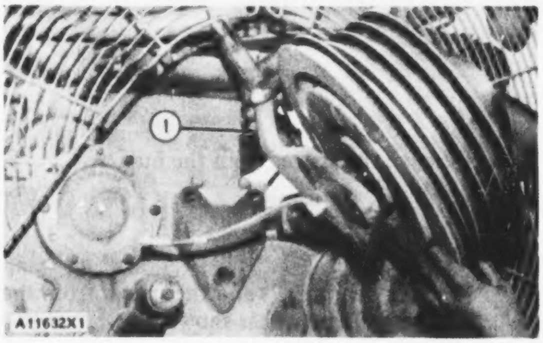


2. Loosen bolts (3) and (4) on the alternator. Remove vee belt (2) from the fan drive.
3. Fasten a hoist to the fan drive.



4. Remove three bolts (6) that hold the fan drive to the timing gear cover.
5. Remove fan drive (5). Weight of the fan drive is 110 lb. (50 kg).

INSTALL FAN DRIVE 12–1359



1. Fasten a hoist to the fan drive.
2. Put the fan drive (1) in position on the timing gear cover. Install the three bolts that hold it in position.
3. Put the vee belt for the alternator in position on the fan drive. Make an adjustment to the vee belt tension. See LUBRICATION AND MAINTENANCE GUIDE for the correct procedure to make an adjustment to the vee belt.
4. Install the other three vee belts on the fan drive. See INSTALL FAN BELT TIGHTENER.

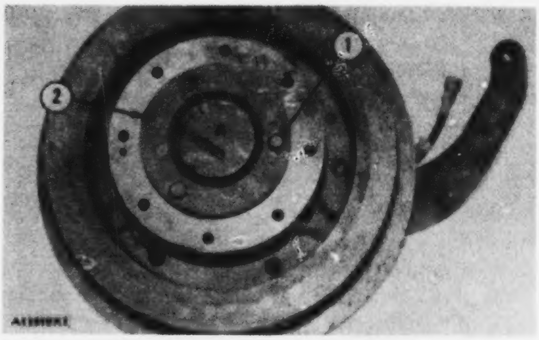
end by:
a) install fan assembly

FAN DRIVE

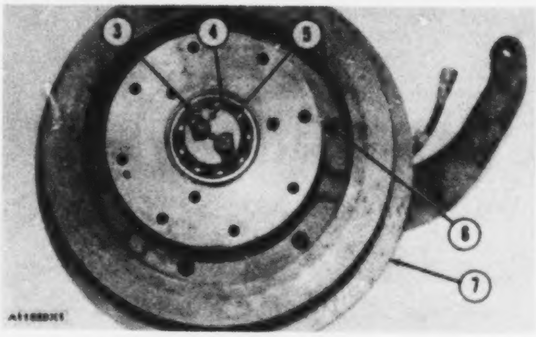
DISASSEMBLE FAN DRIVE 15–1359

Tools Needed		A	B
1P2322	Puller Assembly	1	
1P470	Drive Plate	1	
1P529	Handle		1
1P472	Drive Plate		1
1P479	Drive Plate		1

start by:
a) remove fan drive

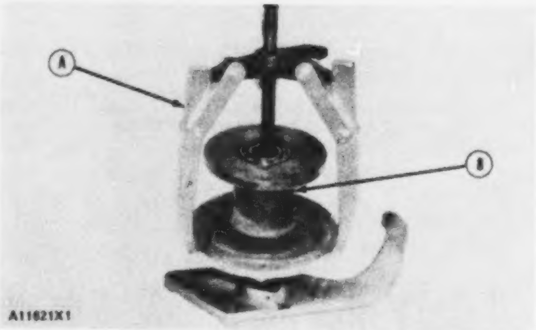


1. Remove the grease hose from the bracket assembly.



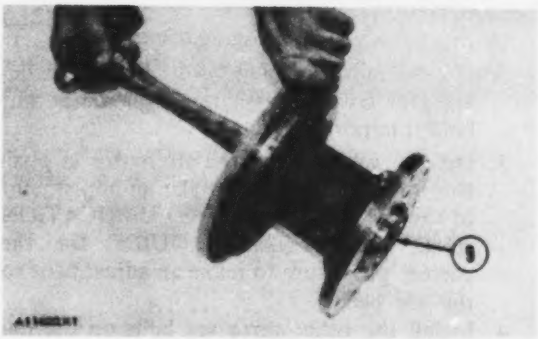
2. Remove three bolts (1) and cover (2) from the hub. Remove the O-ring seal from the cover.

3. Remove two locks (3), two bolts (4) and washer (5) from the bracket assembly.



4. Remove six bolts (6) from the pulley. Remove pulley (7) from the hub.

5. Remove hub (8) from the bracket assembly with tooling (A).

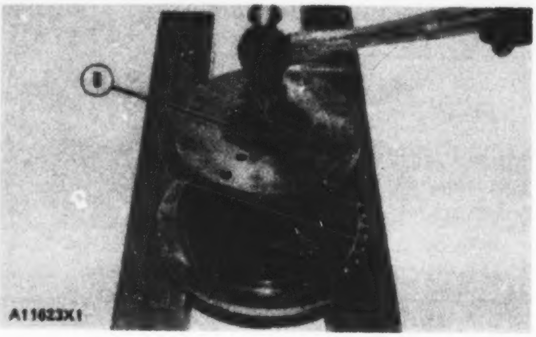


6. Remove the spacer from the hub.

7. Remove bearing (9) and the spacer from the hub with a hammer as shown.

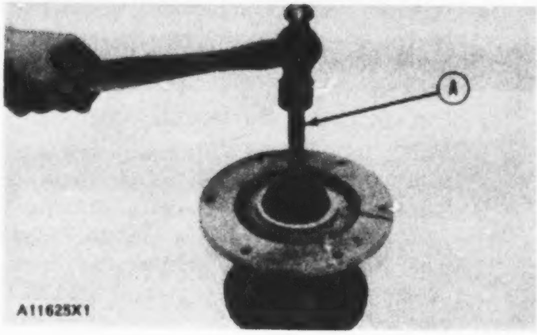
FAN DRIVE

8. Put the hub on wood blocks as shown. Remove the seal and bearing from the hub with tooling (B).

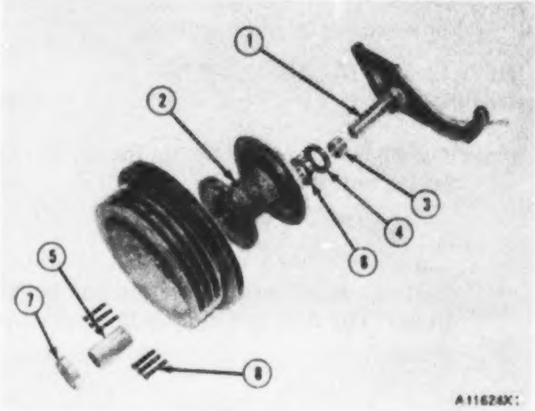


ASSEMBLE FAN DRIVE 16–1359

Tools Needed		A	B
1P529	Handle	1	1
1P495	Drive Plate	1	1
1P472	Drive Plate	1	



1. Install bearing (7) in hub (2) with tooling (A).
2. Install spacer (5) from the opposite side of the hub.
3. Install bearing (6) in hub with tooling (A).
4. Install lip-type seal (4) in the hub with tooling (B). Make sure the lip of the seal is toward the bracket assembly (1). Put 1P808 General Purpose Lubricant on the lip of the seal.
5. Put the hub in the pulley. Install six bolts (8) that hold the hub to the pulley.
6. Put spacer (3) on bracket assembly (1). Install the pulley and hub on the bracket assembly.
7. Install the washer, two locks and two bolts that hold the hub and pulley to the bracket assembly.
8. Install the O-ring seal on the cover for the hub. Put 1P808 General Purpose Lubricant on the O-ring seal. Put the cover in position on the hub. Install the three bolts that hold it.
9. Install the grease hose on the bracket assembly.



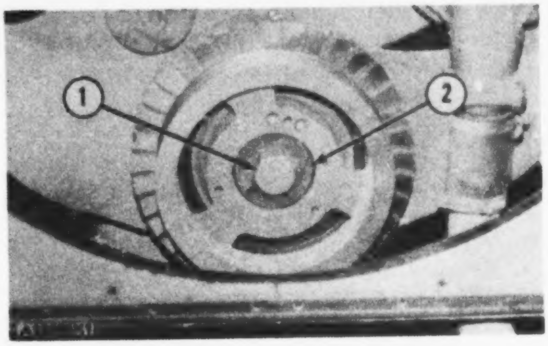
end by:
 a) install fan drive

VABRATION DAMPER AND PULLEY

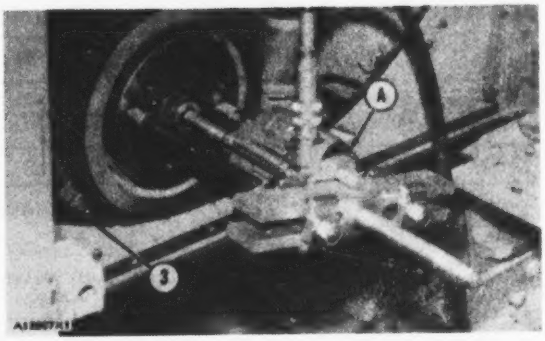
REMOVE VIBRATION DAMPER AND PULLEY 11–1205

	Tools Needed	A
8B7548	Puller Assembly	1
7F9540	Puller Assembly	1
5F7342	Adapter	2
FT1033	Adapter Plate	1
8B7560	Step Plate	1
9S5800	Pump Group	1

start by:
a) remove fan assembly

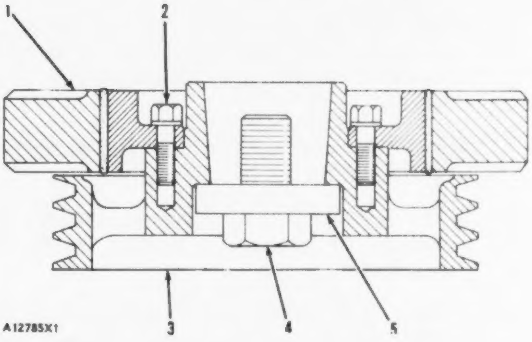


1. Remove bolt (1) and plate (2). Install the adapter plate from tooling (A) and bolt (1) in the pulley. Tighten the bolt until there is a clearance of .50 in. (12.7 mm) between the bolt and the front of the pulley.

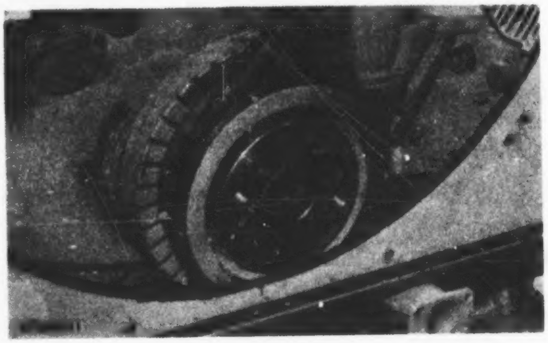


2. Install tooling (A) and loosen the damper and pulley from the taper of the crankshaft.
3. Remove tooling (A). Fasten a hoist to the pulley. Remove bolt (1) and the adapter plate from the pulley. Remove the vibration damper and pulley as a unit. Weight of the unit is 90 lb. (41 kg).
4. Remove the bolts that hold the vibration damper (3) to the pulley. Remove the vibration damper from the pulley.

INSTALL VIBRATION DAMPER AND PULLEY 12–1205



1. Put pulley (3) in position in the damper (1). Install bolts (2).
2. Fasten a hoist to the vibration damper and pulley. Put it in position on the crankshaft.



3. Install plate (5) and bolt (4). Tighten the bolt to a torque of 600 ± 50 lb.ft. (83.0 ± 6.9 mkg). Hit the bolt with a hammer. Tighten the bolt again to a torque of 600 ± 50 lb.ft. (83.0 ± 6.9 mkg).

end by:
a) install fan assembly

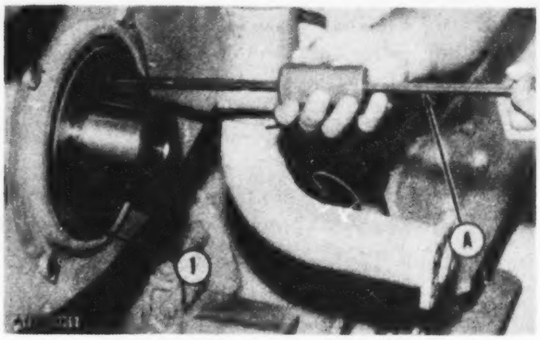
CRANKSHAFT FRONT SEAL

REMOVE CRANKSHAFT FRONT SEAL 11–1160

Tools Needed		A
1P3075	Puller Assembly	1

start by:
a) remove vibration damper and pulley

1. Make two holes (180° apart) in the metal surface of the seal with a punch.
2. Remove the crankshaft front seal (1) from the timing gear cover with tooling (A).

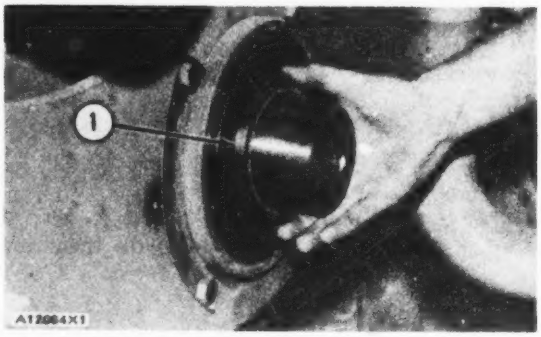


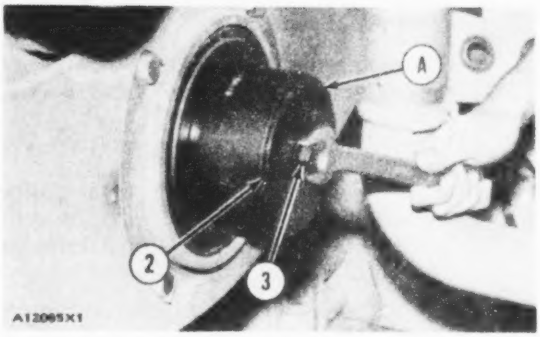
INSTALL CRANKSHAFT FRONT SEAL 12–1160

Tools Needed		A
5P3036	Ring	1
5P3037	Plate	1
2B4705	Bolt	1

1. Make sure the sealing surface of the crankshaft is clean and free of dirt and foreign material.
2. Put clean SAE 30 oil on the rubber lip of the seal and the end of the crankshaft.
3. Put crankshaft seal (1) on the crankshaft with the lip of the seal toward the rear of the engine.
4. Install tooling (A) over the crankshaft and seal as shown.
5. Tighten bolt (3) of tooling (A) until plate (2) of tooling (A) makes contact with the front of the crankshaft.
6. Remove tooling (A). Check the distance from the front face of the seal to the front face of the engine support bushing. The distance must be .54 in. (13.7 mm).

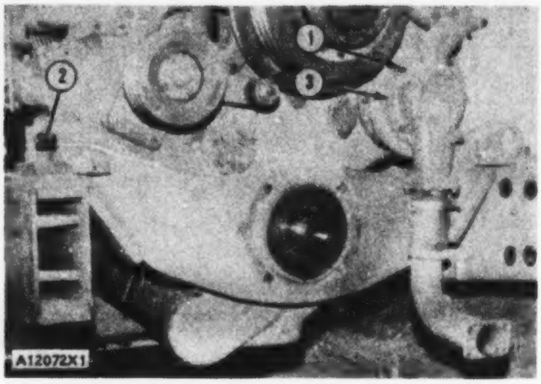
end by:
a) install vibration damper and pulley





ENGINE FRONT SUPPORT

REMOVE ENGINE FRONT SUPPORT 11–1153

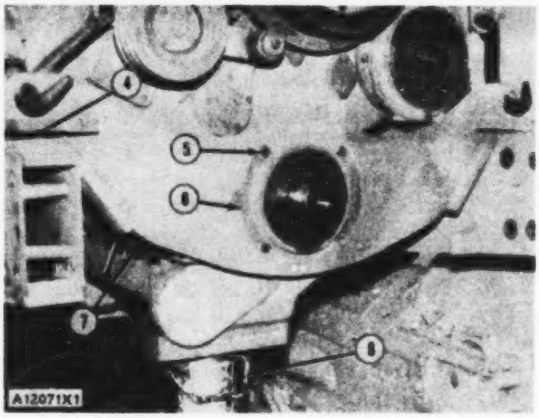


start by:
a) remove radiator and guard
b) remove vibration damper and pulley

1. Remove bolts (1) from cover (3). Use three 3/8"–16 NC forcing screws to remove the cover from the water pump.

2. Remove bolts (2) that hold the engine front support to the frame.

3. Fasten a hoist to the engine front support. Lift the engine and remove shims (4) from both sides of the machine. Put identification on the shims to prevent mixing at assembly.

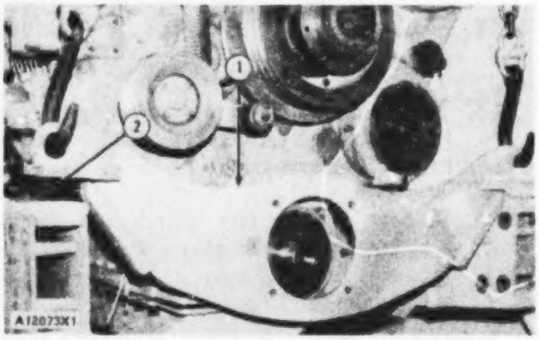


4. Put jack (8) under the engine to keep the engine front support off of the frame. Weight of the front of the engine is 3700 lb. (1678 kg).

5. Remove bolts (5) and locks (6).

6. Remove engine front support (7). Weight of the engine front support is 75 lb. (34 kg).

INSTALL ENGINE FRONT SUPPORT 12–1153



1. Put the front engine support (1) in position over the bushing assembly on the front timing gear cover. Install the two locks and four bolts that hold it in position.
2. Put shims (2) in the original position between the engine front support and the frame.
3. Fasten a hoist to the engine front support. Lift the engine and remove the jack.
4. Lower the engine until the front support is in position on the frame. Install the bolts that hold the engine front support to the frame.
5. Install the cover on the water pump.

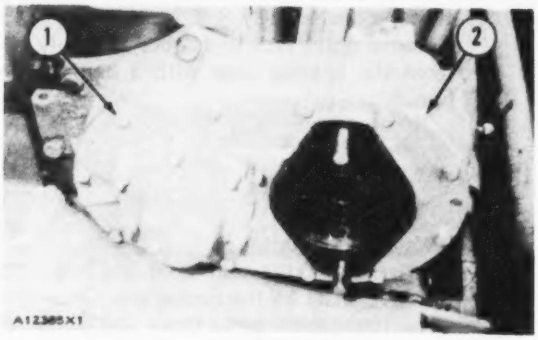
end by:
a) install vibration damper and pulley
b) install radiator and guard

POWER TAKE-OFF DRIVE GEARS AND SHAFT

REMOVE POWER TAKE-OFF DRIVE GEARS AND SHAFT 11–1165

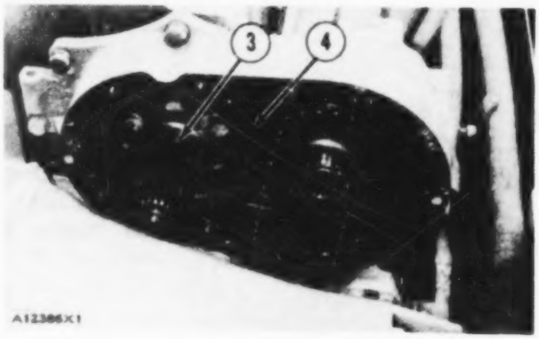
start by:
- a) remove hydraulic pump (if so equipped)
- b) remove fan drive

NOTE: Dash is removed from the machine for better illustration of power take-off gears.



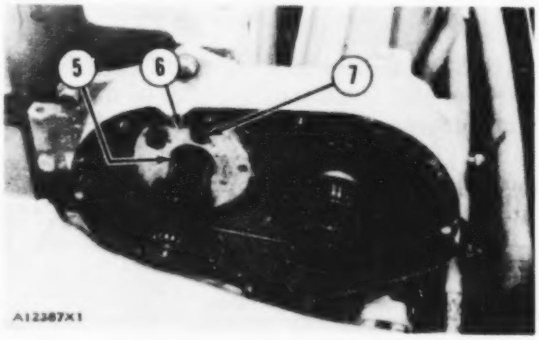
1. Remove bolts (1) and cover (2) from the housing for power take-off.

2. Remove ring (3). Remove drive gear (4).



3. Remove ring (5). Remove bolts (7).

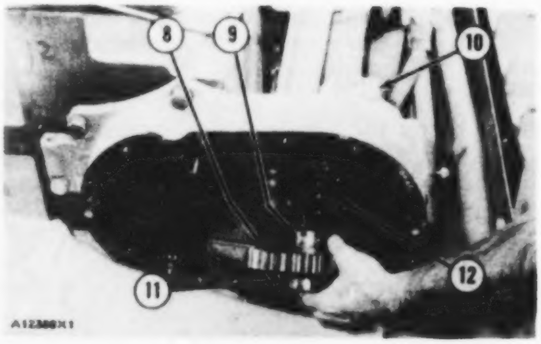
4. Remove bearing cage (6) with three 3/8"–16 NC forcing screws. Remove the bushing from the bearing cage.



5. Remove drive gear (8) for the transmission oil pump.

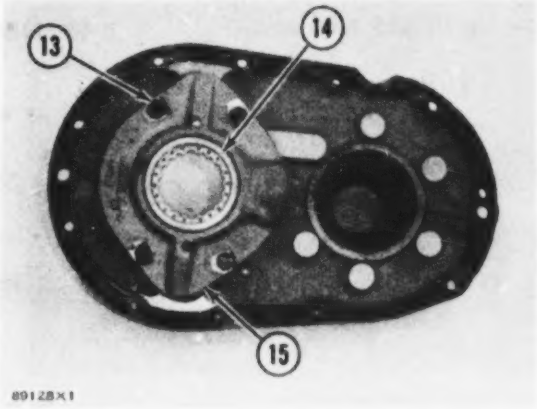
6. Remove bearing races (9) and (11) from the gear.

7. Remove transmission oil pump (10). Remove inner race and roller assembly (12) with a hammer and punch.



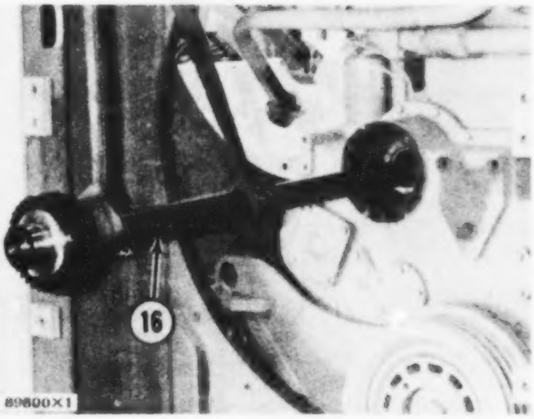
POWER TAKE-OFF DRIVE GEARS AND SHAFT

8. Remove bolts (13) and bearing cage (15). Remove outer race and roller assembly (14) from the bearing cage with a hammer and punch.



9. Remove the bolts that hold the cover for the drive shaft to the timing gear cover. Remove the cover with three 3/8"–16 NC forcing screws.

10. Slide the drive shaft (16) for power take-off toward the front of the engine. Fasten a hoist to the drive shaft and remove it. Weight is 75 lb. (34 kg).



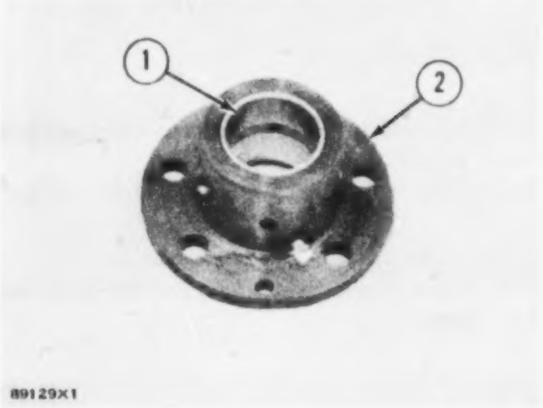
CAUTION: Bearing cage (6) must be removed before removing and installing the drive shaft to prevent damage to the bushing in the bearing cage.

INSTALL POWER TAKE-OFF DRIVE GEARS AND SHAFT 12–1165

	Tools Needed	A
8S2328	Dial Test Indicator Group	1

1. Fasten a hoist to the drive shaft for power take-off and put it in position through the timing gear cover and cylinder block.

2. Lower the temperature of bushing (1). Install the bushing in bearing cage (2). Make sure the oil holes in the bushing and cage are in alignment.



POWER TAKE-OFF DRIVE GEARS AND SHAFT

3. Put bearing cage (2) in position over the drive shaft. Install the bolts that hold it to the housing for power take-off.

4. Lower the temperature of outer race and roller assemblies (10) and (11). Install the outer race and roller assemblies in the housing for power take-off and bearing cage (9).

5. Heat inner races (12) and (13) to a maximum temperature of 600°F (315°C). Install the races on gear (14).

6. Install the oil pump for the transmission on the housing for power take-off. Install gear (14) over the shaft for the oil pump.

7. Install snap ring (4) on the drive shaft. Install drive gear (3) on the drive shaft. Make sure the teeth of gears (3) and (14) are engaged. Install snap ring (5).

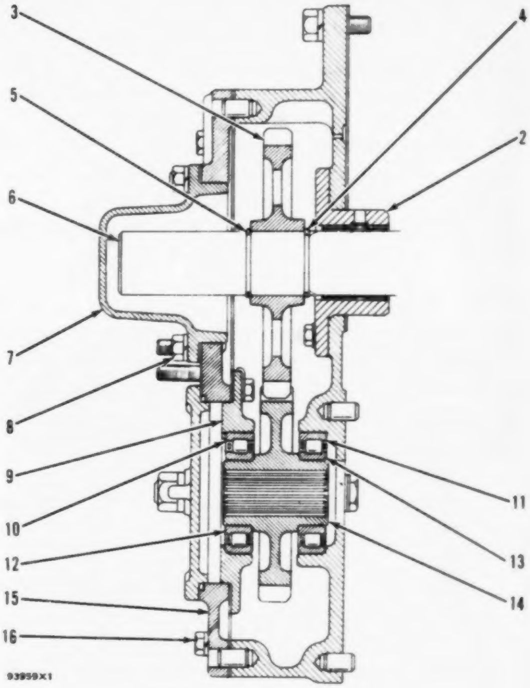
8. Put bearing cage (9) in position in cover (15). Install bolts (16) that hold it.

9. Put cover (7) in position on cover (15). Install nuts (8) that hold it.

10. Put cover (17) in position on the timing gear cover. Install the bolts that hold it.

11. Make a check of the end clearance for drive shafts (6) as follows:
    a) Remove cover (7).
    b) Check the end clearance for the drive shaft with tooling (A).
    c) The end clearance must be .022 to .038 in. (0.56 to 0.97 mm) for new thrust washers.
    d) The maximum permissible end clearance is .060 in. (1.52 mm). If the end clearance is more than .060 in. (1.52 mm), make a replacement of the thrust washers in the timing gear cover and cover (18).
    e) Remove tool group (A). Install cover (7).

end by:
  a) install fan drive
  b) install hydraulic pump (if so equipped)



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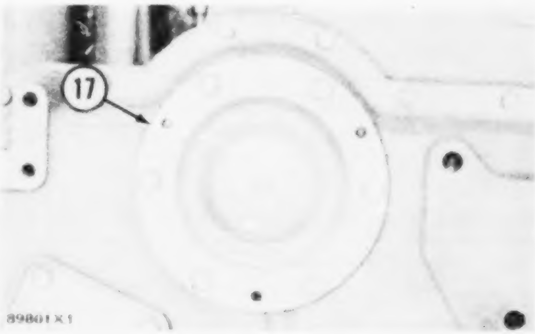

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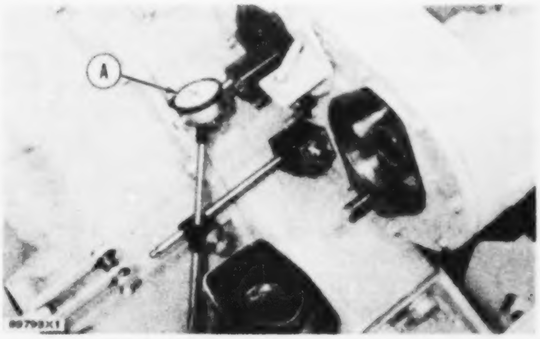

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TIMING GEAR COVER

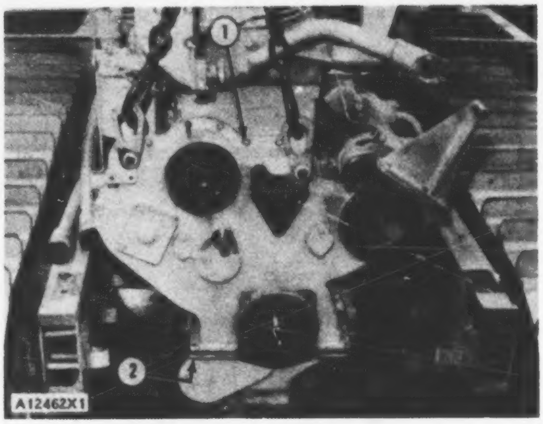
REMOVE TIMING GEAR COVER 11–1166

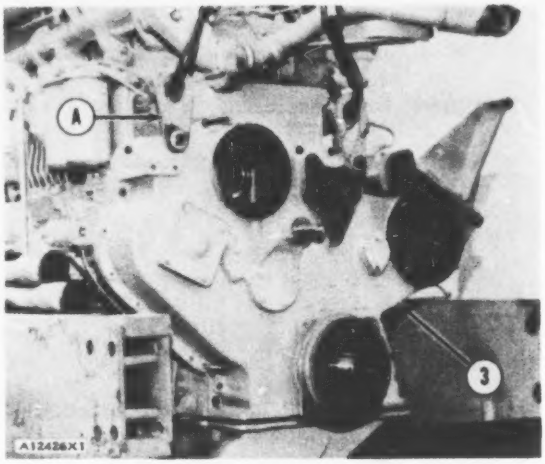
	Tools Needed	A
FT522	Lifting Eye	2

start by:
a) remove alternator
b) remove water pump
c) remove engine front support
d) remove power take-off gears and shaft

NOTE: Before the engine front support is removed, loosen the bolts that hold the oil pan to the cylinder block and timing gear cover. Put spacers between the oil pan and cylinder block. Lift the engine and put a jack in position under the engine. Lower the engine on the jack as shown.

1. Remove bolts (2) that hold the timing gear cover to the oil pan.
2. Remove bolts (1) that hold the timing gear cover to the cylinder block.
3. Install tooling (A) on the timing gear cover as shown.
4. Fasten a hoist to the timing gear cover. Loosen the timing gear cover from its dowels with two 3/8"–16 NC forcing screws. Remove timing gear cover (3). Weight of the timing gear cover is 190 lb. (86 kg).



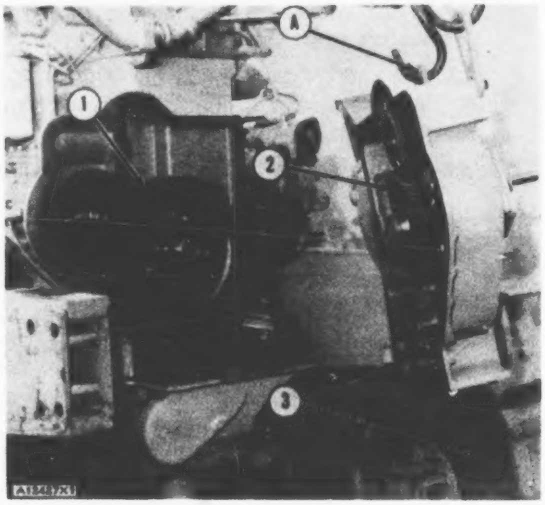


INSTALL TIMING GEAR COVER 12–1166

	Tools Needed	A
FT522	Lifting Eye	2

NOTE: If the gasket for the oil pan has damage, remove the oil pan and install a new gasket.

1. Install a new gasket on the timing gear cover. Cut the bottom of the gasket even with the bottom of the timing gear cover.
2. Put clean SAE 30 oil on the crankshaft and the rubber lip of the crankshaft front seal.
3. Fasten a hoist to tooling (A). Put the timing gear cover (3) in position on the dowels on the cylinder block. Make sure the teeth of the water pump gear (2) engage in the teeth of camshaft gear (1). Install the bolts that hold the timing gear cover to the cylinder block and the accessory drive housing.



TIMING GEAR COVER

end by:

a) install power take-off drive gears and shaft
b) install engine front support
c) install water pump
d) install alternator

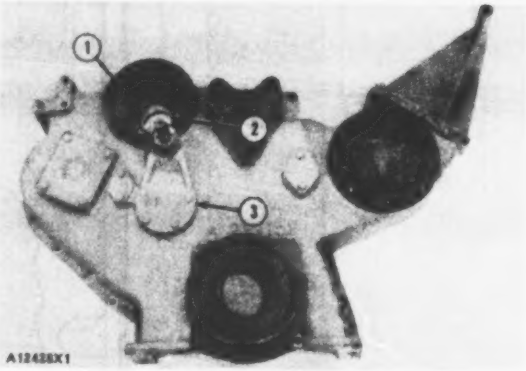
DISASSEMBLE TIMING GEAR COVER

15-1166

Tools Needed		A	B	C	D
1P529	Handle	1		1	1
1P488	Drive Plate	1			
1P492	Drive Plate	1			
8B7548	Puller Group		1		
8B7553	Adapter		1		
8H684	Ratchet Box Wrench		1		
1P470	Drive Plate			1	
1P476	Drive Plate			1	
1P473	Drive Plate				1

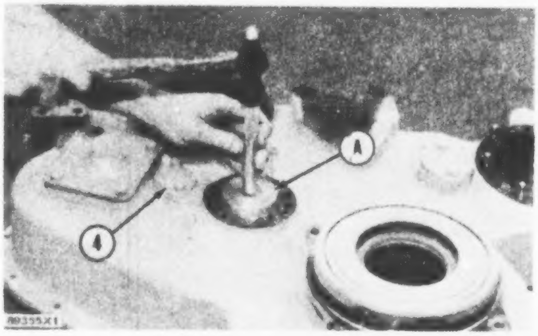
start by:

a) remove timing gear cover.



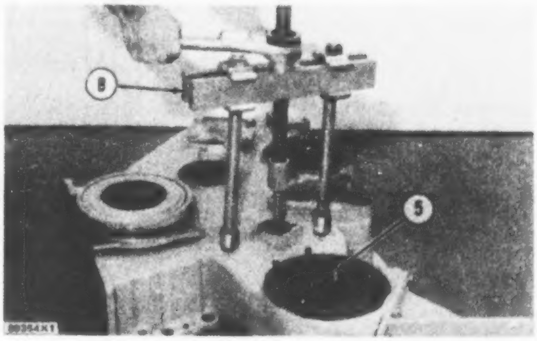
1. Remove bracket (3).

2. Remove the bearings and spacer for camshaft drive gear with tooling (A). Remove the thrust washer.



3. Remove the bearing (2) for power take-off drive gear with tooling (A). Remove thrust washer (1).

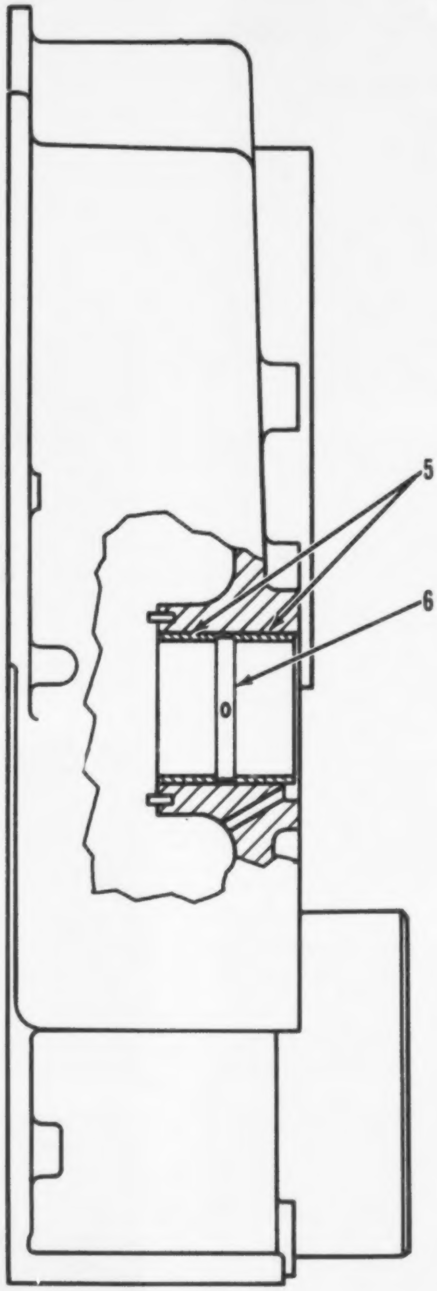
4. Remove cover (4) for water pump idler gear.



5. Remove the shaft from the idler gear with tooling (B). Remove idler gear (5).

6. Remove the plug. Remove the outer bearing for the idler gear with tooling (C). Remove the inner bearing for the idler gear with tooling (D).

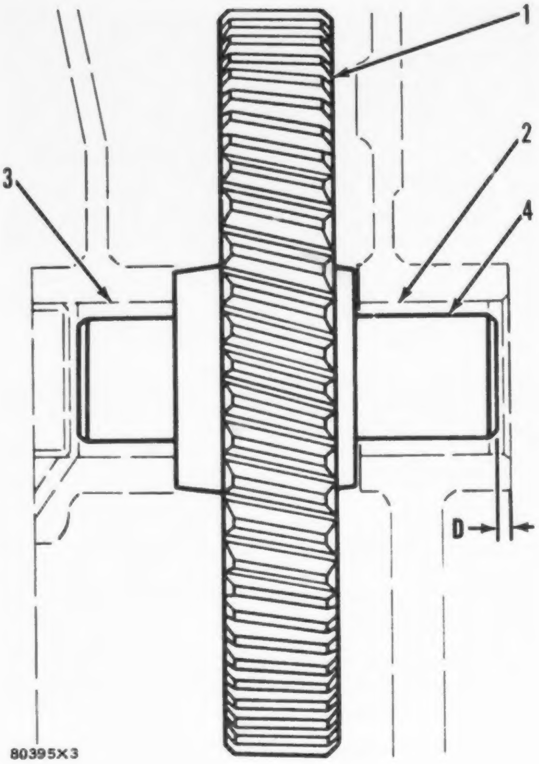
TIMING GEAR COVER



TIMING GEAR COVER

ASSEMBLE TIMING GEAR COVER 16–1166

Tools Needed		A	B	C
1P529	Handle	1	1	1
1P470	Drive Plate	1		
1P476	Drive Plate	1	1	
1P473	Drive Plate		1	
1P492	Drive Plate			1
1P488	Drive Plate			1

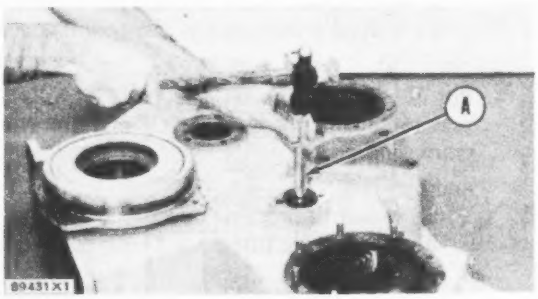


1. Install inner bearing (3) for the water pump idler shaft with tooling (A).

2. Install outer bearing (2) for the idler shaft with tooling (B).

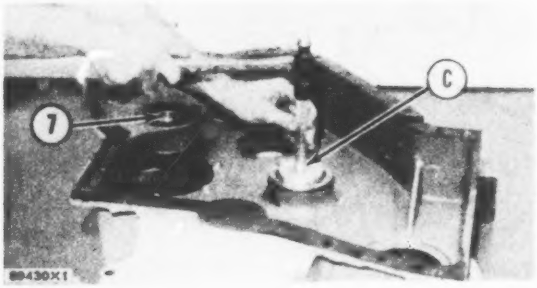
3. Put the idler gear (1) in the timing gear cover so the side of the gear with the longer hub is toward the rear of the engine.

4. Install the shaft (4) through the bearings and gear. Make sure dimension (D) is .188 in. (4.78 mm).



5. Install bearing (7) for the power take-off drive shaft with tooling (C). Install the thrust washer for the shaft over its two dowels.

6. Install bearings (5) and spacer (6) for the camshaft drive gear with tooling (C). Make sure the oil holes are in alignment. The projection of bearings (5) must not be more than .03 in. (0.8 mm) past the inside face of the timing gear cover. Install the thrust washer for the camshaft drive gear over its two dowels.



7. Install the covers for the camshaft drive and water pump drive.

8. Install the bracket for the belt tightener.

end by:
a) install timing gear cover

CAMSHAFT

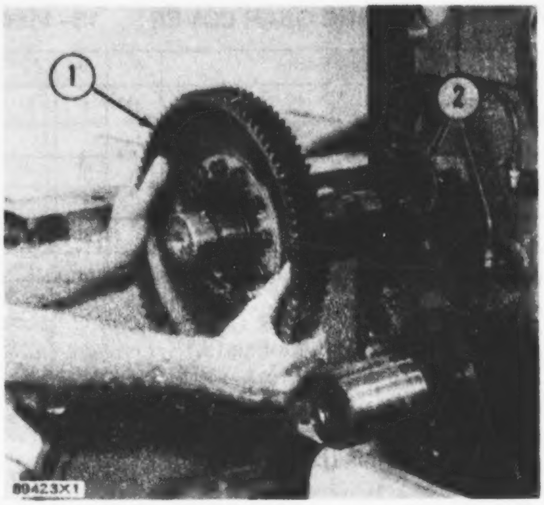
REMOVE CAMSHAFT 11–1210

start by:
a) remove valve lifters
b) remove timing gear cover

1. Carefully pull camshaft (1) from the cylinder block. The rear of the camshaft shaft can be held up through the inspection cover openings on the right side of the cylinder block.
2. Fasten a hoist to the camshaft and remove it. Weight is 100 lb. (45 kg).

CAUTION: Use care not to cause damage to the bearing bores by the cam lobes when the camshaft is being removed.

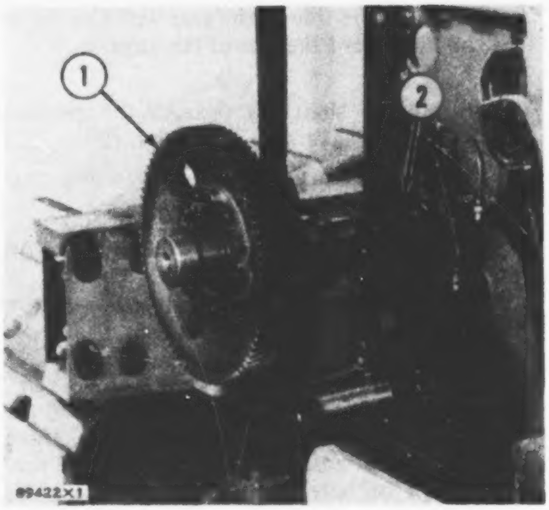
3. Remove thrust washer (2) from the cylinder block.



INSTALL CAMSHAFT 12–1210

1. Install a new thrust washer (2) on the cylinder block.
2. Put clean engine oil on the camshaft bearings. Put graphite grease on the lobes of the camshaft shaft.
3. Fasten a hoist to the camshaft (1). Carefully install the camshaft into the cylinder block. Pull the camshaft shaft through the bearings while holding it through the inspection cover openings.
4. Put the "C" mark on the large camshaft gear in alignment with the "C" mark on the crankshaft gear.

end by:
a) install timing gear cover
b) install valve lifters

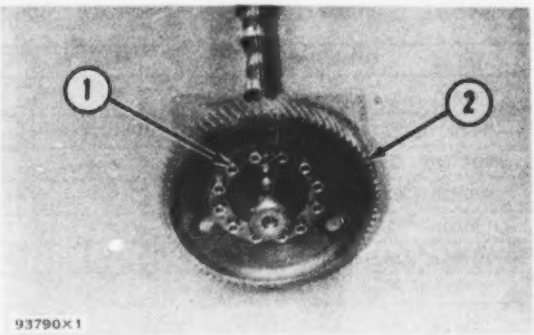


CAMSHAFT

DISASSEMBLE CAMSHAFT 15–1210

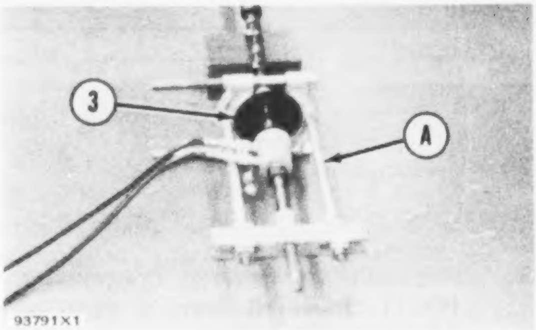
	Tools Needed	A
1H3110	Bearing Puller Attachment	1
1H3107	Puller Assembly	1
1H3108	Leg	2
S2398	Spacer	1
9S5800	Pump Group	1
7F9540	Puller Assembly	1

start by:
a) remove camshaft



1. Remove nuts (1), lock and bolts.

2. Remove large camshaft gear (2).



3. Remove small camshaft gear (3) with tooling (A).

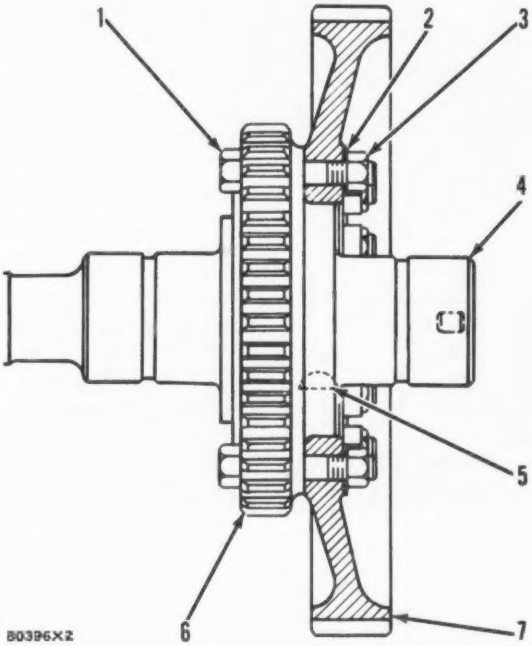
4. Remove the key from under the small gear.

ASSEMBLE CAMSHAFT 16–1210

1. Install key (5) in the camshaft (4).

2. Heat small camshaft gear (6) to a maximum temperature of 750°F (399°C). Install the gear over the key and shaft.

3. Put large camshaft gear (7) in position on the small gear. Install bolts (1), lock (2), and nuts (3) that hold it.



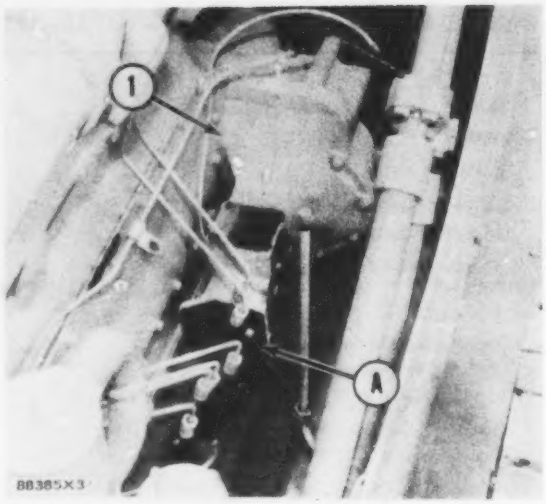
NOTE: Make sure the "C" mark on the large camshaft gear is toward the front of the camshaft.

end by:
a) install camshaft

TIMING GEARS

REMOVE TIMING GEARS 11–1206

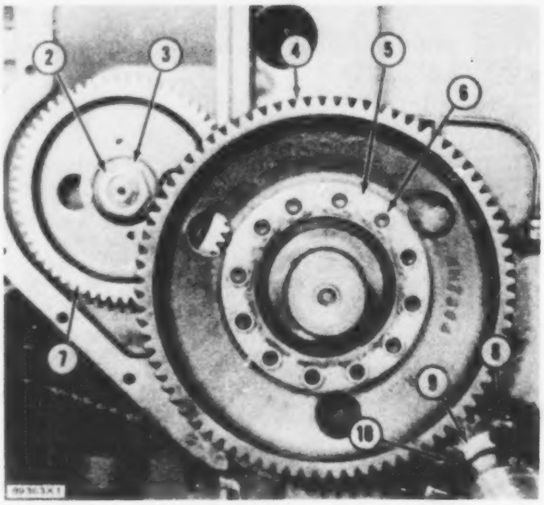
Tools Needed		A	B	C
5P4240	Timing Plate	1		
8H700	Puller Assembly		1	
8B7560	Step Plate		1	
9S5800	Pump Group			1
1P820	Puller Group			1
5F7342	Adapter			2
3H465	Plate			4
1B4207	Nut			2
8B7549	Leg			2
S2398	Spacer			1
5F7343	Bearing Puller Attachment			1



start by:

a) remove fuel injection pump housing and governor

b) remove timing gear cover



1. Turn crankshaft so No. 1 piston is at top center on compression stroke. See FINDING TOP CENTER COMPRESSION POSITION FOR NO. 1 PISTON in TESTING AND ADJUSTING.

2. Install tool (A) on the rear of the accessory drive housing (1).

CAUTION: Use care when removing and installing the camshaft gear to prevent doing damage to the valve lifters and camshaft bearings.

3. Remove nuts (6) and lock (5). Remove camshaft gear (4).

4. Remove nut (2) and washer (3). Remove accessory drive gear (7) with tooling (B). Remove the key from the accessory drive shaft.

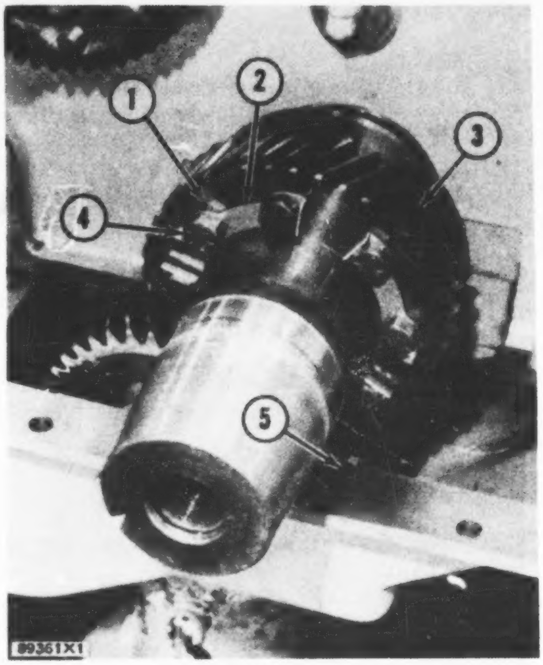
5. Remove the front section of the oil pan.

6. Remove bolts (10) and locks (9). Remove crankshaft gear (8) with tooling (C).

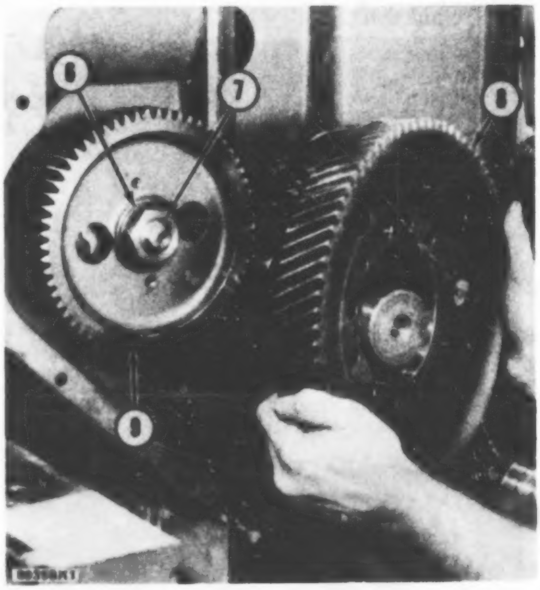
TIMING GEARS

INSTALL TIMING GEARS 12–1206

Tools Needed		A
5P4240	Timing Plate	1



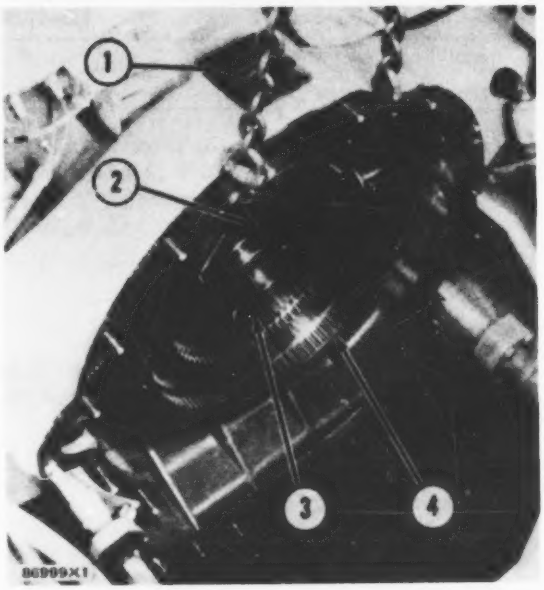
1. Heat crankshaft gear (3) in oil to a maximum temperature of 300°F (149°C). Install the gear on the crankshaft with "C" marks (1) in position as shown. Install locks (2) and bolts (4) that hold it.
2. Put the front section of the oil pan (5) in position on the cylinder block. Install the bolts that hold it.
3. Install the key in the accessory drive shaft. Install accessory drive gear (9) on the shaft. Install washer (6) with its larger inside diameter toward the gear. Install nut (7). Tighten the nut to a torque of 125 ± 10 lb.ft. (17.3 ± 1.4 mkg).
4. Put camshaft gear (8) in position on the camshaft. Make sure the "C" mark on the camshaft gear is in alignment with the "C" mark on the crankshaft gear. Install lock and nuts that hold it.
5. Remove tool (A) from the rear of the accessory drive housing.



end by:
- a) install timing gear cover
- b) install fuel injection pump housing and governor

FLYWHEEL

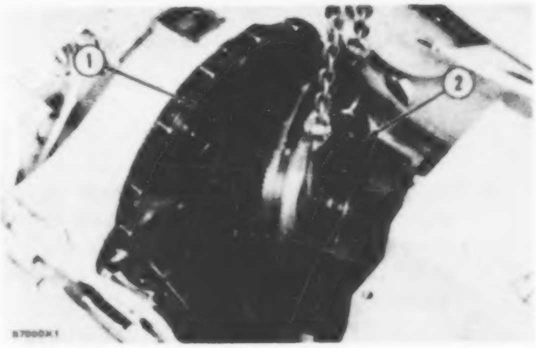
REMOVE FLYWHEEL 11–1156



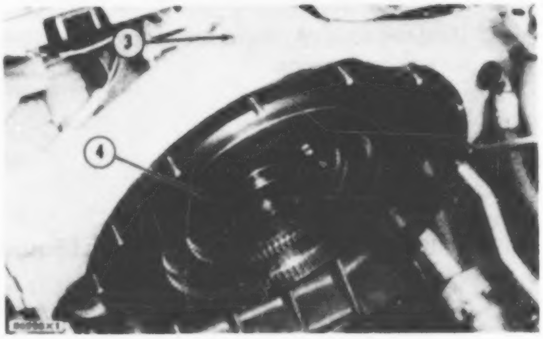
start by:
a) remove torque divider (power shift machine) or flywheel clutch (direct drive machine)

1. Remove the cover for the timing pointer. Remove the timing pointer (1).
2. Remove the top bolt that holds the flywheel to the crankshaft. Install a 3/4"–16 NF guide bolt (2) in the crankshaft.
3. Install two 3/8"–16 NC forged eyebolts in the flywheel. Fasten a hoist to the eyebolts.
4. Remove the other bolts (3) that hold the flywheel to the crankshaft.
5. Remove the flywheel (4). Weight is 160 lb. (73 kg).

INSTALL FLYWHEEL 12–1156



1. Install a 3/4"–16 NF guide bolt (1) in the crankshaft.
2. Install two 3/8"–16 NC forged eyebolts in the flywheel. Fasten a hoist to the eyebolts. Put the flywheel (2) in position on the crankshaft over the guide bolt.
3. Install bolts (4). Remove the guide bolt and install the other bolt. Tighten the bolts to a torque of 280 ± 20 lb.ft. (38.8 ± 2.8 mkg).



4. Install the timing pointer on the flywheel housing. Install cover (3) for the timing pointer.

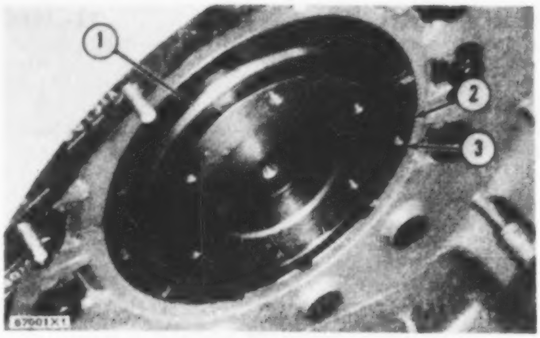
end by:
a) install flywheel clutch (direct drive machine) or torque divider (power shift machine)

CRANKSHAFT REAR SEAL RING AND THROWER

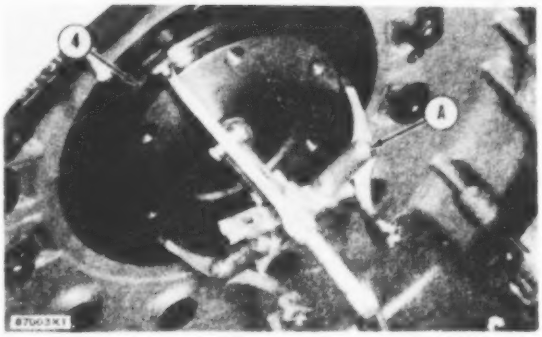
REMOVE CRANKSHAFT REAR SEAL RING AND THROWER 11–1161

	Tools Needed	A
8H700	Puller Assembly	1
8B7561	Step Plate	1
FT884	Leg	3

start by:
a) remove flywheel



1. Remove bolts (3), locks (2), and baffle (1).
2. Remove the rear seal ring from the thrower.



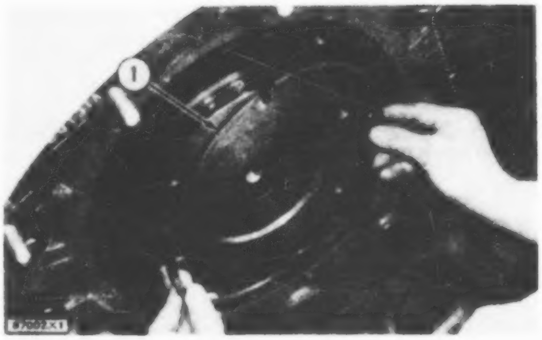
3. Install tooling (A) on thrower (4). Heat the outer diameter of the thrower with an open flame to a maximum temperature of 400°F (205°C). Put a force on the thrower immediately with tooling (A) and remove the thrower.

INSTALL CRANKSHAFT REAR SEAL RING AND THROWER 12–1161

	Tools Needed	A
FT108	Handle	1
FT101	Driver	1

CAUTION: Do not use an old oil thrower that has been removed from the crankshaft.

1. Heat the thrower to a maximum temperature of 500°F (260°C). Install the thrower on the crankshaft with tooling (A). Make sure the thrower is against the flange on the crankshaft.
2. Put a light amount of clean engine oil on the rear seal ring and the surface that its inside diameter makes contact with.



3. Install the rear seal ring (1) with the opening at the top and the face of the seal with the word "out" toward the flywheel.
4. Put the baffle in position on the crankshaft. Install the locks and bolts that hold it.

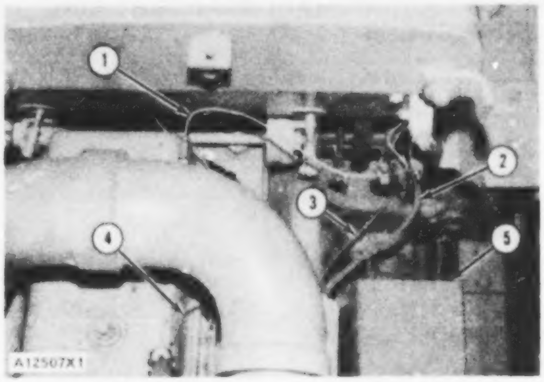
end by:
a) install flywheel

ENGINE

REMOVE ENGINE 11–1000

	Tools Needed	A
FT118	Lifting Bracket	1

start by:
- a) remove radiator and guard
- b) remove crankcase guards (front)
- c) remove universal joint

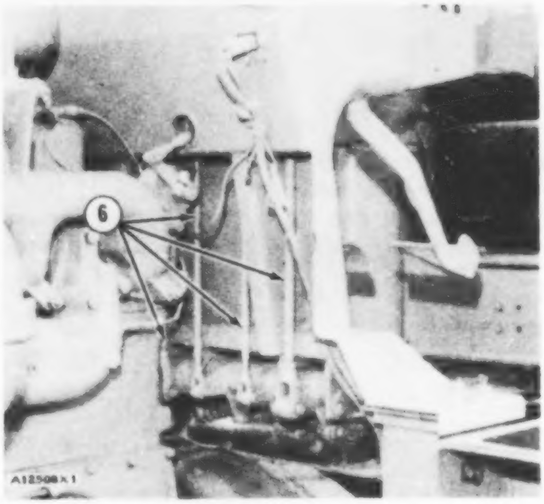


1. Drain the oil from the transmission, torque converter or flywheel clutch and the hydraulic tank.

2. Remove tool box (5).

3. Disconnect air filter indicator line (1) from the elbow.

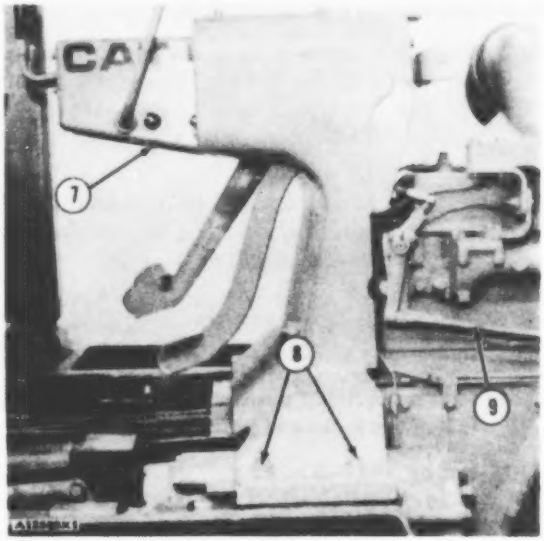
4. Disconnect wiring harness (2).



5. Disconnect water temperature line (3) from the engine.

6. Disconnect the indicator line from the water manifold.

7. Disconnect the wire (4) for the glow plugs.



8. Disconnect four rods (6) for the steering clutch controls and the brake pedals.

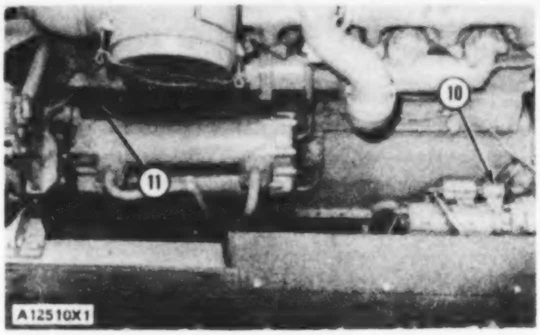
9. Disconnect governor control rod (9) and the decelerator rod from the engine.

10. Remove six bolts (8) that hold the dash in position.

11. Fasten a hoist to the dash. Remove dash (7). Weight of the dash is 300 lb. (136 kg).

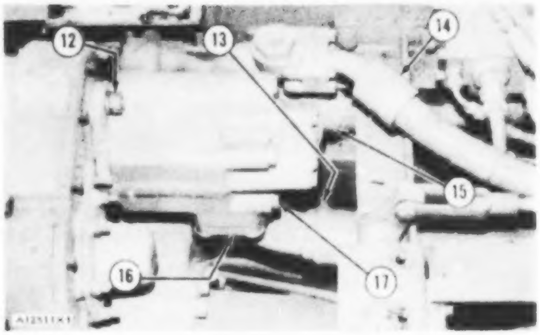
ENGINE

12. Disconnect wires (11) for the alternator. Disconnect wires (10) for the starter. Put identification on the wires to prevent mixing at assembly.



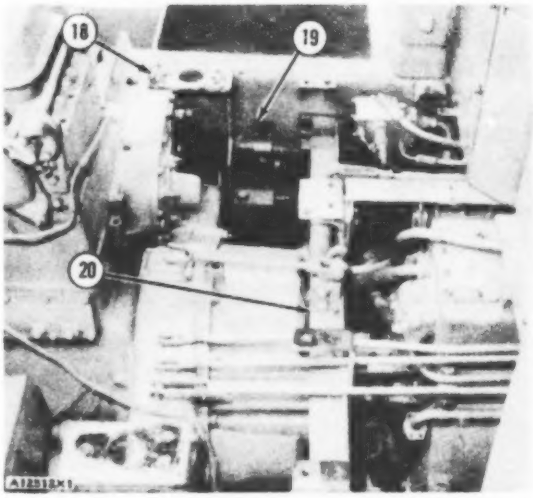
13. Disconnect lines (13), (14), (15) and (16) from the hydraulic pump.

14. Remove two nuts (12) that hold the hydraulic pump in position. Remove hydraulic pump (17).



15. Remove two brackets (18) from the machine.

16. Remove support (20) from between the fenders.

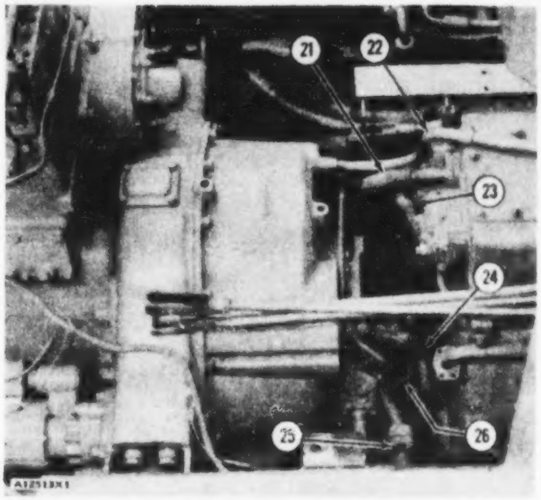


17. Remove clamps (19) that hold the hydraulic lines to the frame of the machine.

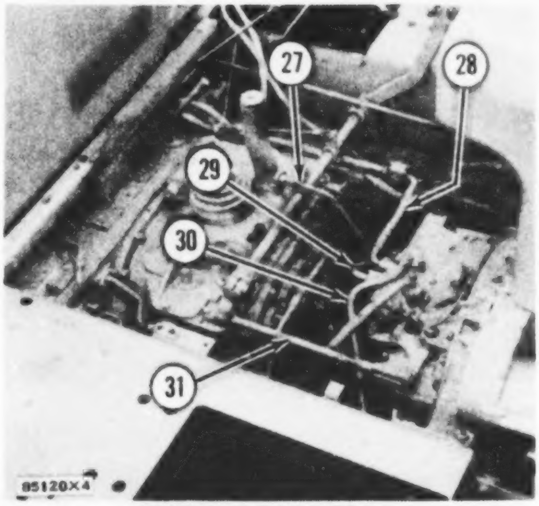
18. Move the hydraulic lines away from the engine.

ENGINE

19. For power shift machine:
    a. Disconnect torque divider oil supply line (21) and vent tube (22).
    b. Disconnect transmission supply line (23).
    c) Disconnect steering clutch and brake controls oil supply line (24). Disconnect lubrication line (26) and suction line (25).



20. For direct drive machine:
    a. Remove oil lines (28), (29) and (30) from the hydraulic control mechanism.
    b. Remove vent line (27).
    c. Disconnect rod (31) from the bellcrank.



TYPICAL EXAMPLE

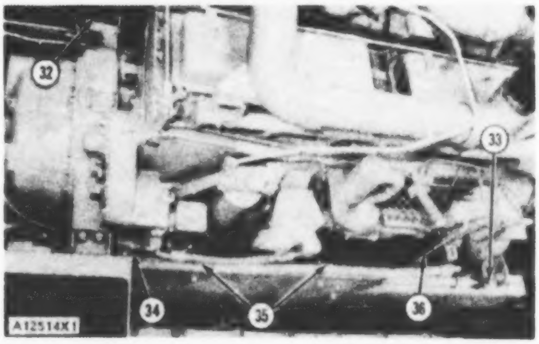
21. Remove two clamps (35). Move the two hydraulic lines away from the frame of the machine.

22. Disconnect fuel line (36).

23. Remove oil line (34) to the transmission magnetic strainer.

24. Remove four bolts (33) from the engine front support.

25. Remove four bolts (32) from the flywheel housing.



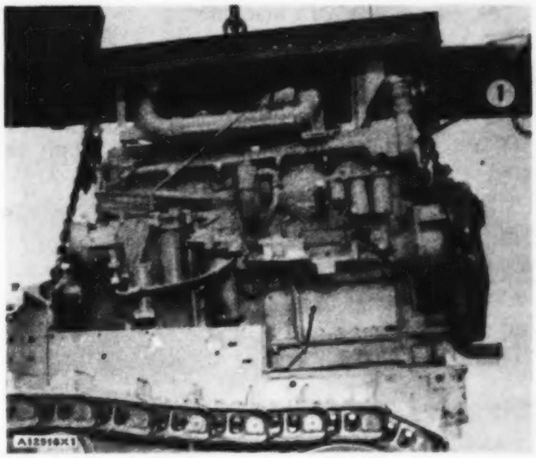
26. Fasten tool (A) to a hoist and the engine. Remove the engine from the machine. Weight of the engine is 7100 lb. (3221 kg).

27. Remove the shims from under the engine front support after the engine is removed. Put identification on the shims as to their location under the engine front support.

ENGINE

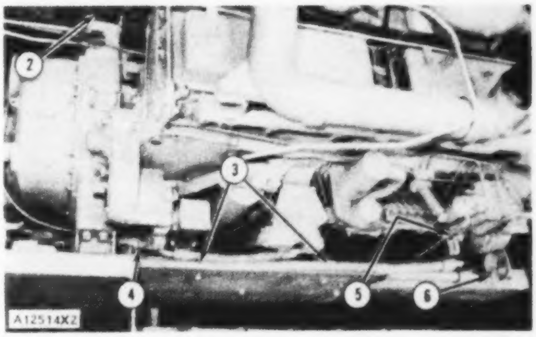
INSTALL ENGINE 12–1000

	Tools Needed	A
FT118	Lifting Bracket	1



1. Put the shims for the front of the engine on the frame of the machine. Make sure the shims are in the correct positions.

2. Fasten a hoist to the engine. Put engine (1) in position on the frame of the machine. Make sure the brackets on the flywheel housing engage over the dowels on the frame.



3. Install four bolts (2) that hold the rear of the engine to the frame.

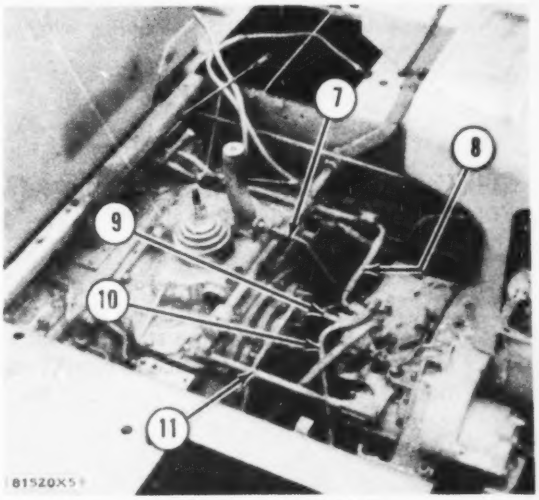
4. Install four bolts (6) that hold the front of the engine to the frame.

5. Connect oil line (4) to the transmission magnetic strainer.

6. Connect fuel line (5) to the fuel filter base.

7. Install two clamps (3) that hold the hydraulic lines to the side of the frame.

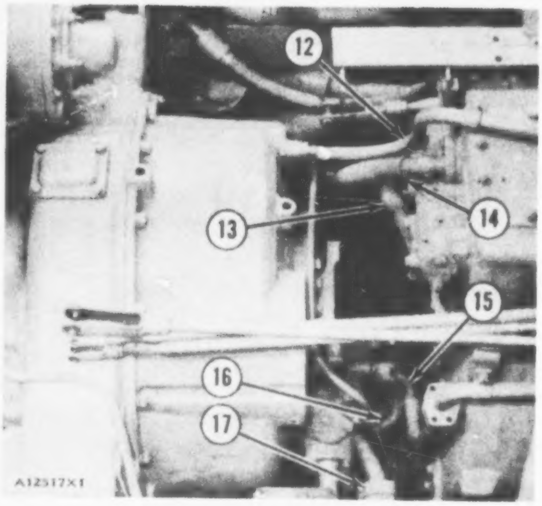
8. For direct drive machine:
   a. Connect rod (11) to the bellcrank.
   b. Connect vent line (7).
   c. Connect oil lines (8), (9) and (10) to the hydraulic control mechanism.



TYPICAL EXAMPLE

ENGINE

9. For power shift machine:
   a. Connect suction line (17) to the torque divider. Connect lubrication line (16) to the torque divider. Connect steering clutch and brake controls oil supply line (15) to the torque divider.
   b. Connect transmission oil supply line (13).
   c. Connect vent tube (12) to the torque divider. Connect the oil supply line (14) to the torque divider.

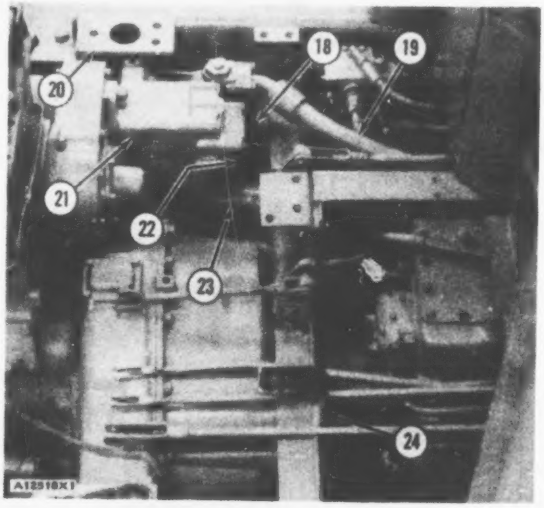


10. Put the two hydraulic lines for the cylinders along the frame of the machine. Install the clamp that holds them in position.

11. Install support (24) between the fenders.

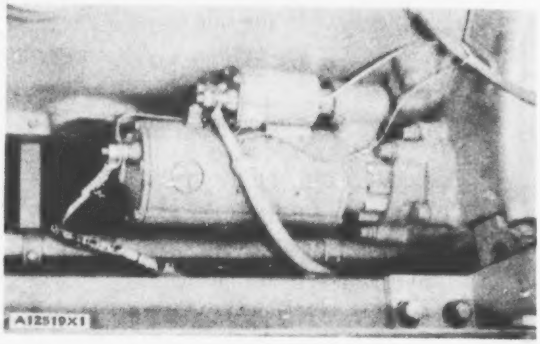
12. Install two brackets (20) for the dash.

13. Put hydraulic pump (21) in position on the power take-off shaft. Install the two nuts that hold it.



14. Connect oil lines (18), (19), (22) and (23) to the hydraulic pump as shown.

15. Connect the wires to the starter as shown. Make sure the wires are in the correct position.



16. Connect the wires to the alternator. Make sure the wires are in the correct positions.

ENGINE

17. Fasten a hoist to the dash. Put dash (25) in position on the machine. Install the six bolts and washers that hold it.

18. Connect governor control rod (27) and decelerator rod (26) to the levers as shown.

19. Connect the four rods to the dash for the steering clutch controls and the brake pedals.

20. Connect air filter indicator line (28) to the elbow for the air cleaner assembly.

21. Connect wire (31) for the glow plugs.

22. Connect line (30) for the water temperature gauge.

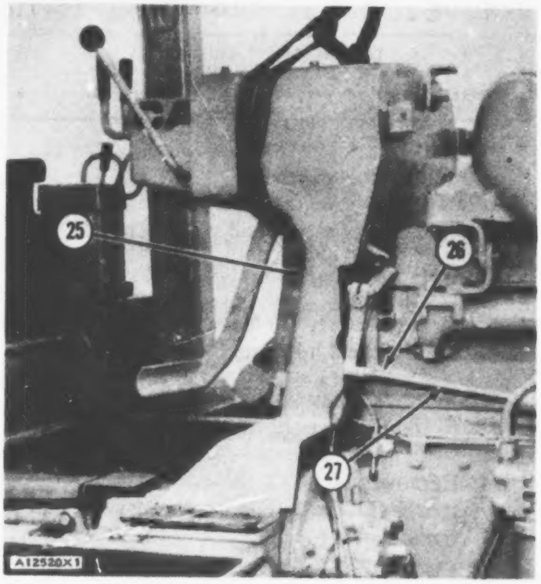
23. Connect the pressure line to the water manifold.

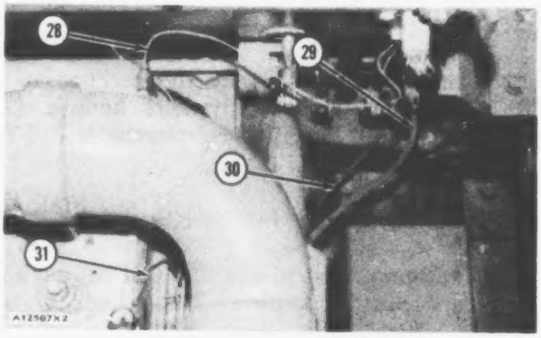
24. Connect the main wiring harness (29).

25. Install the tool box.

26. Fill the transmission, torque divider or flywheel clutch and hydraulic tank with oil to the correct level. See LUBRICATION AND MAINTENANCE GUIDE.

end by:
- a) install universal joint
- b) install crankcase guards (front)
- c) install radiator and guard





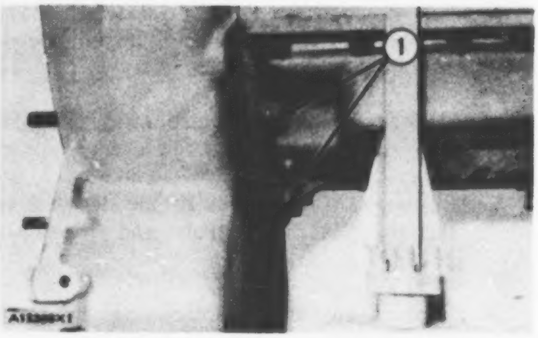
FLYWHEEL HOUSING

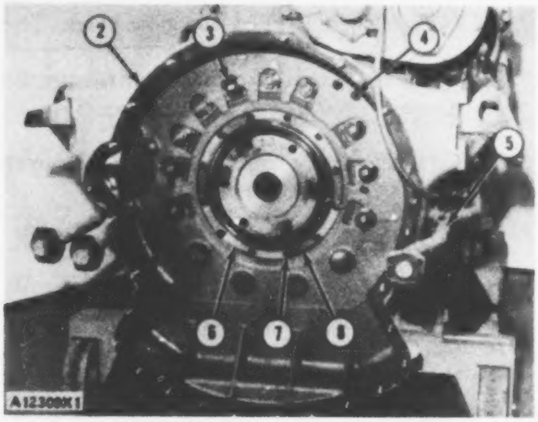
REMOVE FLYWHEEL HOUSING 11–1157

	Tools Needed	A
9S8500	Engine Stand	1

start by:
- a) remove engine
- b) remove flywheel
- c) remove electric starting motor

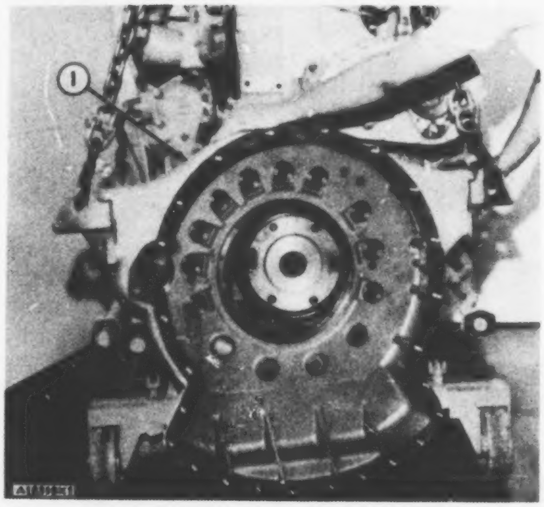
1. Install the engine on tool (A).
2. Remove bolts (1) that hold the oil pan to the flywheel housing.
3. Remove clamps (5) that hold the oil tubes to the flywheel housing.
4. Remove six locks (8) and twelve bolts (7) that hold the baffle to the crankshaft. Remove baffle (6).
5. Fasten a hoist to the supports on the flywheel housing.
6. Remove two bolts (4). Remove ten nuts (3) and locks that hold the flywheel housing in position. Remove flywheel housing (2). Weight of the flywheel housing is 250 lb. (113 kg).





INSTALL FLYWHEEL HOUSING 12–1157

1. Fasten a hoist to the flywheel housing (1) and put it in position on the cylinder block.
2. Install two bolts, ten locks and nuts that hold the flywheel housing in position.
3. Install the bolts that hold the oil pan to the flywheel housing.
4. Install the clamps that hold the oil tubes to the flywheel housing.
5. Install the baffle on the crankshaft. Install the bolts and locks that hold it.



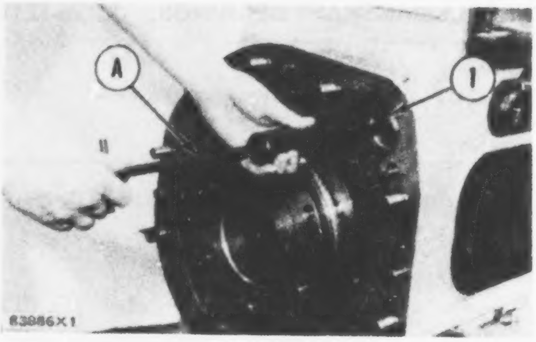
end by:
- a) install electric starting motor
- b) install flywheel
- c) install engine

CAMSHAFT BEARINGS

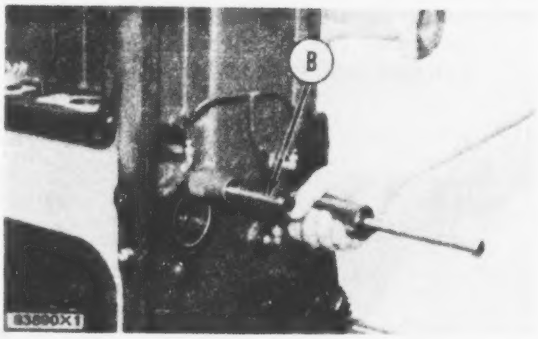
REMOVE CAMSHAFT BEARINGS 11–1211

Tools Needed		A	B	C
1P3075	Puller Group	1		
5P944	Dowel Puller Group		1	
8S2241	Camshaft Bearing Removal & Installation Tool Group			1
5P1667	Spacer			1

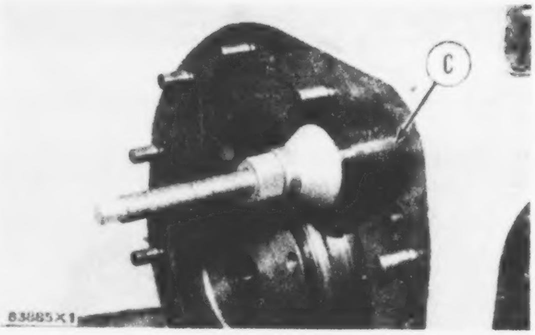
start by:
a) remove camshaft
b) remove flywheel housing



1. Use tool group (A) to remove plug (1) from cylinder block.



2. Use tool group (B) to remove one of the dowels for thrust washer.



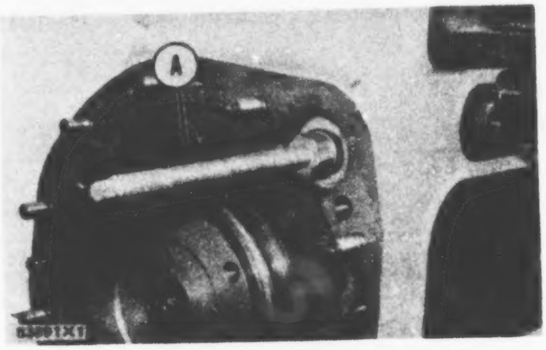
3. Use tooling (C) to remove the camshaft bearings.

CAMSHAFT BEARINGS

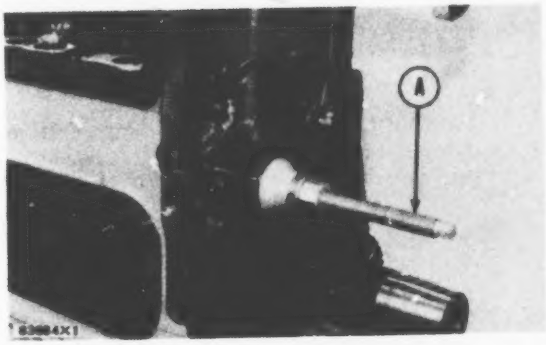
INSTALL CAMSHAFT BEARINGS 12–1211

	Tools Needed	A
8S2241	Camshaft Bearing Removal & Installation Tool Group	1
5P1667	Spacer	1

1. Use tool group (A) to install camshaft bearings in cylinder block.

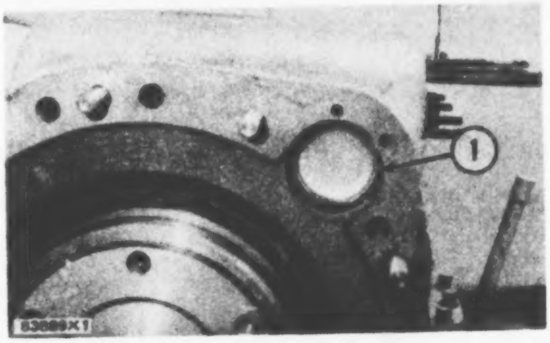


2. Install the front bearings and spacer with tool group (A). Install spacer in alignment with oil hole in cylinder block.



3. Install the dowel in front of cylinder block.

4. Install the plug (1) in rear of cylinder block.



end by:
a) install camshaft
b) install flywheel housing

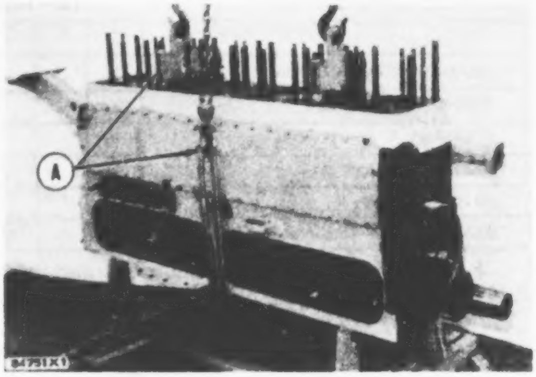
CRANKSHAFT

REMOVE CRANKSHAFT 11–1202

	Tools Needed	A
9S9060	Dual Hook Hoist	1
9S9090	Lifting Eye	2
9S9081	Sling Assembly	1
9S9077	Spacer	4

start by:

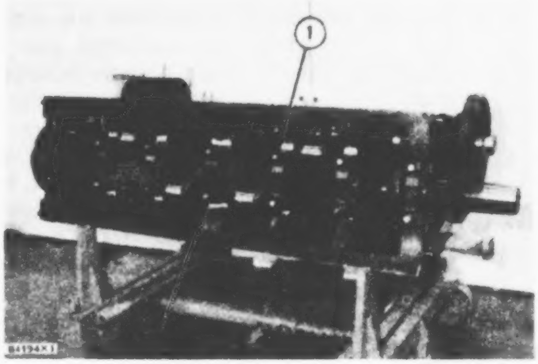
a) remove oil pan
b) remove timing gear cover
c) remove flywheel housing
d) remove pistons
e) remove fuel injection pump housing and governor drive housing
f) remove oil filter base



1. Install lifting eyes, spacers, and sling assembly of tooling (A).

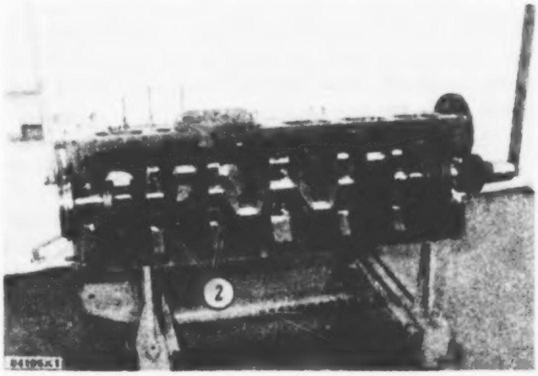
2. Fasten the dual hoist of tooling (A).

3. Use tooling (A) to turn the engine on its side as shown. Weight is approximately 2500 lb. (1134 kg).



4. Remove No. 2, 3, 5, 6 main bearing caps (1). Install cut rubber hoses (2) over the studs to prevent damage to crankshaft.

5. Install one of the bolts that holds flywheel, and the bolt that holds hub on the ends of crankshaft.



6. Fasten a hoist to crankshaft and remove main bearing caps No. 1, 4, 7. Remove the crankshaft from engine. Weight is 500 lb. (227 kg).

7. Remove the upper halves of main bearings from cylinder block. Remove the lower halves of main bearings from bearing caps.

CRANKSHAFT

INSTALL CRANKSHAFT

12–1202

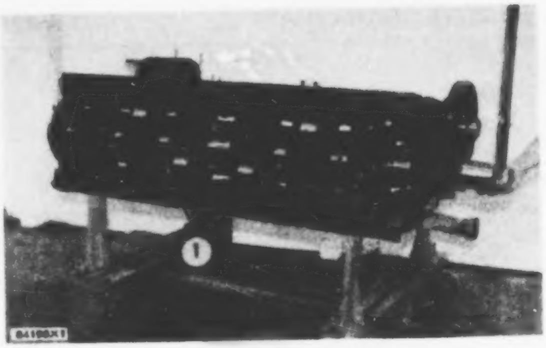
Tools Needed		A	B	C
9S9060	Dual Hook Hoist	1		
9S9090	Lifting Eye	2		
9S9081	Sling Assembly	1		
9S9077	Spacer	4		
5B1161	Wire		•	
8S2328	Dial Test Indicator Group			1

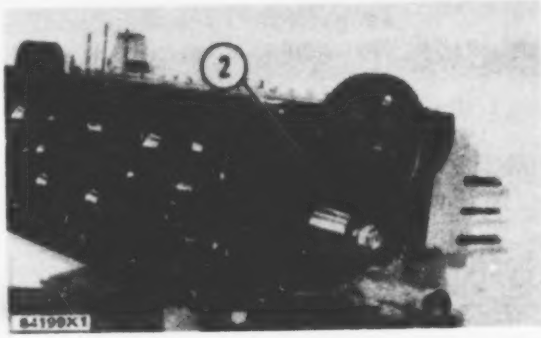
1. Install upper halves of main bearings in cylinder block. Put clean engine oil on bearings.
2. Fasten a hoist to crankshaft. Put split rubber hoses (1) on the studs to prevent damage to crankshaft.
3. Put the crankshaft in position on engine with "C" mark (2) on crankshaft gear in alignment with "C" mark on large camshaft gear.
4. Install lower bearings in bearing caps. Install thrust bearing (3) for center main bearing.
5. Check bearing clearance with wire (B). Install bearing caps, washers, and nuts. Tighten nuts evenly to 100 ± 5 lb.ft. (13.8 ± 0.7 mkg) plus an extra 120° ± 5°. Remove caps and check thickness of wire (B) to find bearing clearance. Bearing clearance must be .004 to .007 in. (0.10 to 0.18 mm) with new parts. Maximum permissible clearance with used parts is .010 in. (0.25 mm).

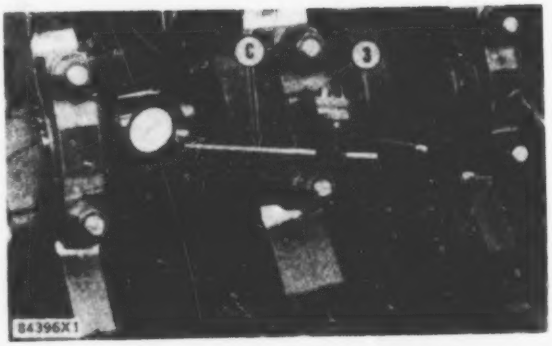
NOTE: Be sure bearing caps are installed so number on cap is same as number on cylinder block. Both numbers must be on same side of cylinder block.

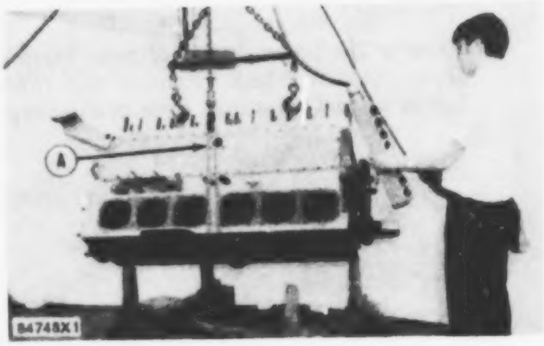
6. Put clean engine oil on threads of studs and seat for nuts. Install main bearing caps and tighten nuts to 100 ± 5 lb.ft. (13.8 ± 0.7 mkg). Put a mark on nuts and on caps. Tighten nuts an extra 120° ± 5° from mark.
7. Use indicator group (C) to check end play of crankshaft as controlled by center main. End play with new parts must be .012 to .019 in. (0.30 to 0.48 mm). Maximum permissible end play with used parts is .035 in. (0.89 mm).
8. Use tooling (A) to turn engine in upward position.

end by:
- a) install pistons
- b) install fuel injection pump housing and governor drive housing
- c) install timing gear cover
- d) install flywheel housing
- e) install oil pan
- f) install oil filter base

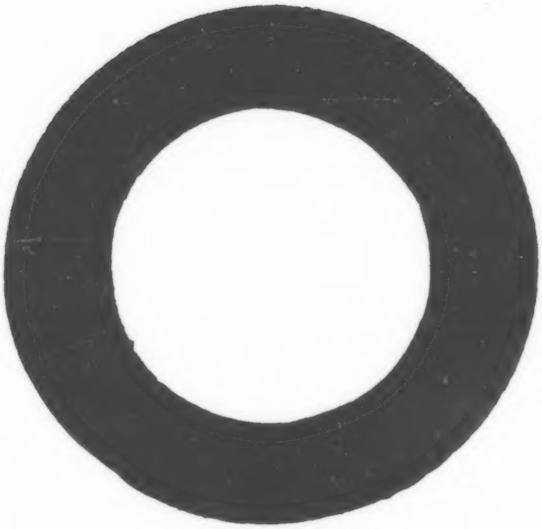








CHAPTER 3
POWER TRAIN



FORM NO. SENR7007

POWER TRAIN SPECIFICATIONS

FOR

D8 TRACTOR

SERIAL NUMBERS
66V1-UP
76V1-UP
77V1-UP

INTRODUCTION

The specifications in this book are given on the basis of information that was current at the time the book was written. These specifications give the torques, operating pressures, measurements of new parts and other items. When the word "permissible" is used in the description, the specification value given is the "maximum or minimum" normally permitted before adjustment, repair and/or new parts are needed. Make a comparison of the measurements of a worn part with the specifications of a new part to find

measurements of a worn part with the specifications of a new part to find

the amount of wear. The wear factor is not the only basis for the replacement of parts. The expected service life of the worn part is a factor. A part that is worn can be safe to use if an estimate of the remainder of its service life is good. When a disassembly is made for the purpose of reconditioning, the recommendations is the replacement of parts not completely worn out if a short service life is expected.

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NOTE: For Systems Operation and Testing and Adjusting, make reference to D8 POWER TRAIN, Form No. SENR7005, for POWER SHIFT TRANSMISSION TESTING AND ADJUSTING see Form No. SENR7006.

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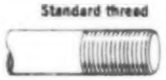
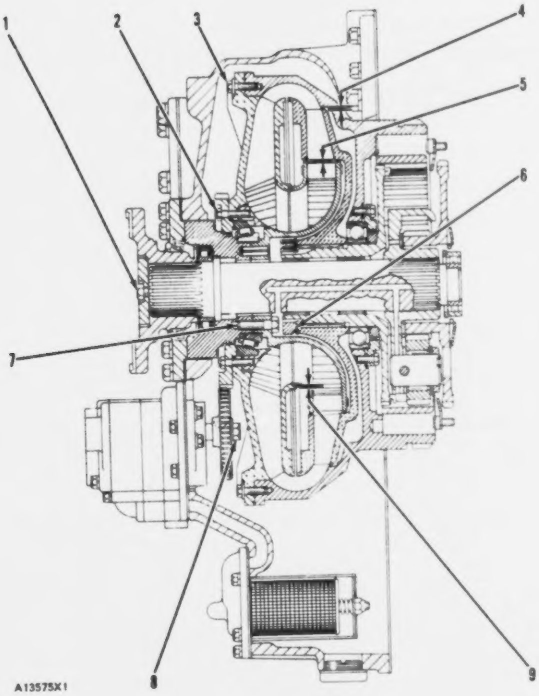
GENERAL TIGHTENING TORQUE FOR BOLTS, NUTS AND TAPERLOCK STUDS

The following charts give the standard torque values for bolts, nuts and taperlock studs of SAE Grade 5 or better quality. Exceptions are given in the Specifications.

THREAD DIAMETER		STANDARD TORQUE	
inches	millimeters	lb. ft.	mkg
 Standard thread		Use these torques for bolts and nuts with standard threads.	
1/4	6.35	9 ± 3	1.24 ± 0.4
5/16	7.94	18 ± 5	2.5 ± 0.7
3/8	9.53	32 ± 5	4.4 ± 0.7
7/16	11.11	50 ± 10	6.9 ± 1.4
1/2	12.70	75 ± 10	10.4 ± 1.4
9/16	14.29	110 ± 15	15.2 ± 2.0
5/8	15.88	150 ± 20	20.7 ± 2.8
3/4	19.05	265 ± 35	36.6 ± 4.8
7/8	22.23	420 ± 60	58.1 ± 8.3
1	25.40	640 ± 80	88.5 ± 11.1
1 1/8	28.58	800 ± 100	110.6 ± 13.8
1 1/4	31.75	1000 ± 120	138 ± 16.6
1 3/8	34.93	1200 ± 150	166 ± 20.7
1 1/2	38.10	1500 ± 200	207 ± 27.7
		Use these torques for bolts and nuts on hydraulic valve bodies.	
5/16	7.94	13 ± 2	1.8 ± 0.3
3/8	9.53	24 ± 2	3.3 ± 0.3
7/16	11.11	39 ± 2	5.4 ± 0.3
1/2	12.70	60 ± 3	8.3 ± 0.4
5/8	15.88	118 ± 4	16.3 ± 0.5
Taperlock stud		Use these torques for studs with Taperlock threads.	
1/4	6.35	5 ± 2	0.69 ± 0.3
5/16	7.94	10 ± 3	1.4 ± 0.4
3/8	9.53	20 ± 3	2.8 ± 0.4
7/16	11.11	30 ± 5	4.1 ± 0.7
1/2	12.70	40 ± 5	5.5 ± 0.7
9/16	14.29	60 ± 10	8.3 ± 1.4
5/8	15.88	75 ± 10	10.4 ± 1.4
3/4	19.05	110 ± 15	15.2 ± 2.0
7/8	22.23	170 ± 20	23.5 ± 2.8
1	25.40	260 ± 30	35.9 ± 4.1
1 1/8	28.58	320 ± 30	44.2 ± 4.1
1 1/4	31.75	400 ± 40	55 ± 5.5
1 3/8	34.93	480 ± 40	66 ± 5.5
1 1/2	38.10	550 ± 50	76 ± 7

T95416-5

TORQUE DIVIDER
(POWER SHIFT)



(1) Torque for the bolt that holds the flange to the output shaft . . . . 85 ± 5 lb.ft. (11.8 ± 0.7 mkg)

(2) Torque for the bolts that hold the drive gear for the pump to the impeller . . . . 36 ± 2 lb.ft. (5.0 ± 0.3 mkg)

(3) Torque for the bolts that hold the impeller to the housing . . . . 36 ± 2 lb.ft. (5.0 ± 0.3 mkg)

(4) Clearance between the turbine and the housing:

Across the diameter (new) . . . . .055 to .075 in. (1.0 to 1.91 mm)

Maximum permissible across the diameter . . . . .0975 in. (2.477 mm)

(5) Clearance between the turbine and the stator:

Across the diameter (new) . . . . .012 to .018 in. (0.30 to 0.46 mm)

Maximum permissible across the diameter . . . . .0225 in. (0.572 mm)

(6) Torque for the nut that holds the turbine to the flange (minimum) . . . . 150 lb.ft. (20.7 mkg)

(7) Torque for the bolts that hold the stator to the carrier . . . . 81 ± 4 lb.ft. (11.2 ± 0.6 mkg)

(8) Torque for the nut that holds the drive gear for the pump to the shaft for the pump . . . . 85 ± 5 lb.ft. (11.8 ± 0.7 mkg)

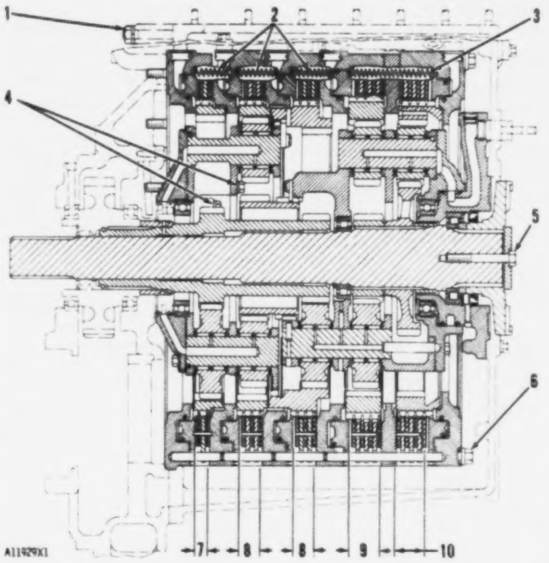
(9) Clearance between the impeller and the stator:

Across the diameter (new) . . . . .009 to .015 in. (0.23 to 0.38 mm)

Maximum permissible across the diameter . . . . .018 in. (0.46 mm)

NOTE: FOR TORQUE VALUES NOT GIVEN, SEE THE FIRST PAGE OF SPECIFICATIONS FOR GENERAL TIGHTENING TORQUES

POWER SHIFT TRANSMISSION



(1) Torque for the nuts that hold the case of the transfer gear to the transmission case . . . . 45 ± 5 lb.ft. (6.2 ± 0.7 mkg)

(2) 9H5537 Springs for the No. 3, No. 4 and No. 5 clutches:

Length under test force . . . . 1.844 in. (46.84 mm)
Test force . . . . 28.75 ± 2.30 lb. (13.0 ± 1.0 kg)
Free length after test . . . . 2.469 in. (62.71 mm)
Outside diameter .563 in. (14.30 mm)

(3) 7H7658 Springs for the No. 1 and No. 2 clutches:

Length under test force . . . . 4.156 in. (105.56 mm)
Test force . . . . 42 ± 3.3 lb. (19.1 ± 1.5 kg)
Free length after test . . . . 5.531 in. (140.49 mm)
Outside diameter .563 in. (14.30 mm)

(4) Torque for the bolts . . . . 40 ± 3 lb.ft. (5.5 ± 0.4 mkg)

(5) Torque for the bolt that holds the flange to the shaft . . . . 85 ± 5 lb.ft. (11.8 ± 0.7 mkg)

(6) Torque for the bolts that hold the clutch housings together . . . . 85 ± 5 lb.ft. (11.8 ± 0.7 mkg)

(7) Thickness of two new discs and one new plate for the No. 5 clutch . . . . .679 to .697 in. (17.25 to 17.70 mm)

Thickness of one new 7M1385 Disc . . . . .216 to .222 in. (5.49 to 5.64 mm)

Thickness of one new 3P1686 Plate . . . . .247 to .253 in. (6.27 to 6.43 mm)

(8) Thickness of three new discs and two new plates for the No. 3 and No. 4 clutches . . . . 1.142 to 1.72 in. (29.01 to 29.77 mm)

Thickness of one new 7M1385 Disc . . . . .216 to .222 in. (5.49 to 5.64 mm)

Thickness of one new 3P1686 Plate . . . . .247 to .253 in. (6.27 to 6.43 mm)

(9) Thickness of four new discs and three new plates for the No. 2 clutch . . . . 1.605 to 1.647 in. (40.77 to 41.85 mm)

Thickness of one new 8M5070 Disc . . . . .216 to .222 in. (5.49 to 5.46 mm)

Thickness of one new 3P1687 Plate . . . . .247 to .253 in. (6.27 to 6.43 mm)

(10) Thickness of four new discs and three new plates for the No. 1 clutch . . . . 1.605 to 1.647 in. (40.77 to 41.85 mm)

Thickness of one new 5S7830 Disc . . . . .216 to .222 in. (5.49 to 5.64 mm)

Thickness of one new 3P1686 Plate . . . . .247 to .253 in. (6.27 to 6.43 mm)

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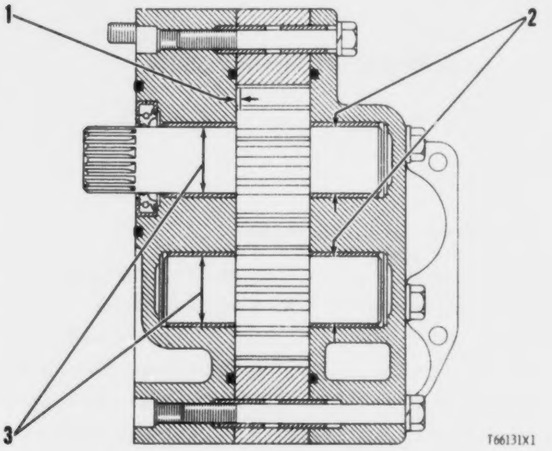
TRANSMISSION OIL PUMP
(POWER SHIFT)
(3P4855)



Rotation (seen from drive end) .... Clockwise

3P4855 Pump:

Output .... 32.9 U.S. gpm (124.5 lit/min)

at a pump speed of .... 1882 rpm

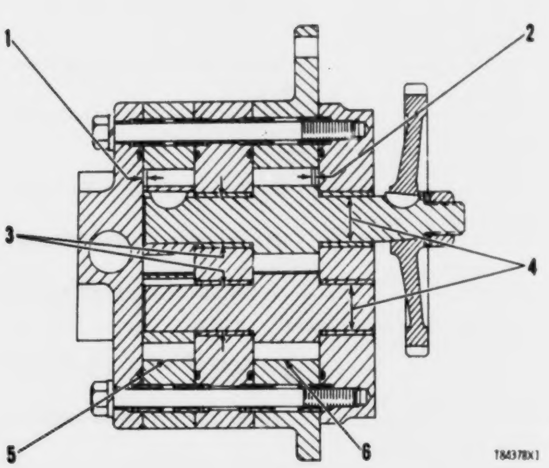
at a pressure of .... 415 psi (29.2 kg/cm²)

(1) Clearance between the gears and cover .... .0027 ± .0008 in. (0.069 ± 0.020 mm)

(2) Diameter of the shafts .... 1.2497 ± .0002 in. (31.742 ± 0.005 mm)

(3) Bore of the bearings .... 1.2514 ± .0003 in. (31.786 ± 0.008 mm)

SCAVENGE AND CIRCULATING OIL PUMP
(POWER SHIFT)
(7S7400)



Rotation (seen from drive end) .... Counterclockwise

(1) Clearance between the gears and the cover .... .0029 to .0041 in. (0.074 to 0.104 mm)

(2) Clearance between the gears and the cover .... .0019 to .0031 in. (0.048 to 0.079 mm)

(3) Diameter of the shafts .... .8745 to .8749 in. (22.212 to 22.222 mm)

(4) Bore of the bearings .... .8760 to .8766 in. (22.250 to 22.266 mm)

(5) Scavenge section:

Output .... 31.4 U.S. gpm (118.8 lit/min)

at a pump speed of .... 2480 rpm

at a pressure of .... 0 psi (0.0 kg/cm²)

(6) Circulating section:

Output .... 21.3 U.S. gpm (80.6 lit/min)

at a pump speed of .... 2480 rpm

at a pressure of .... 40 psi (2.8 kg/cm²)

NOTE: FOR TORQUE VALUES NOT GIVEN, SEE THE FIRST PAGE OF SPECIFICATIONS FOR GENERAL TIGHTENING TORQUES

PRESSURE CONTROL VALVE
(POWER SHIFT)
(1P4145)

(1) Torque for bolts .... 35 ± 3 lb.ft. (4.8 ± 0.4 mkg)

(2) 9H2367 Spring:

Length under test force .... .938 in. (23.83 mm)

Test force .... .30 to .36 lb. (0.15 to 0.16 kg)

Free length after test .... 1.156 in. (29.36 mm)

Outside diameter .... .34 in. (8.6 mm)

(3) 4M5923 Spring for pressure differential valve:

Length under test force .... 3.19 in. (81.0 mm)

Test force .... 41.8 ± 3.3 lb. (19.0 ± 1.5 kg)

Free length after test .... 4.38 in. (111.3 mm)

Outside diameter .... .81 in. (20.6 mm)

(4) Torque for bolts .... 35 ± 3 lb.ft. (4.8 ± 0.4 mkg)

(5) 4M2381 Spring:

Length under test force .... .48 in. (12.2 mm)

Test force .... .517 ± .041 lb. (0.23 ± 0.02 kg)

Free length after test .... .89 in. (22.6 mm)

Outside diameter .... .300 in. (7.62 mm)

(6) 2M3469 Spring for modulation relief valve:

First test:

Length under test force .... 4.510 in. (114.55 mm)

Test force .... 24.7 ± 2.2 lb. (11.2 ± 1.0 kg)

Second test:

Length under test force .... 3.728 in. (94.69 mm)

Test force .... 85.2 ± 4.45 lb. (38.6 ± 2.02 kg)

Free length after test .... 4.83 ± .06 in. (122.7 ± 1.5 mm)

Outside diameter .... .800 ± .016 in. (20.32 ± 0.41 mm)

(7) 5M9622 Spacer for modulation relief valve:

Thickness of spacer .... .062 in. (1.57 mm)

Outside diameter of spacer .... .812 in. (20.62 mm)

One spacer will change pressure .... 15.6 psi (1.10 kg/cm²)

5M9623 Spacer for modulation relief valve:

Thickness of spacer .... .036 in. (0.91 mm)

Outside diameter of spacer .... .812 in. (20.62 mm)

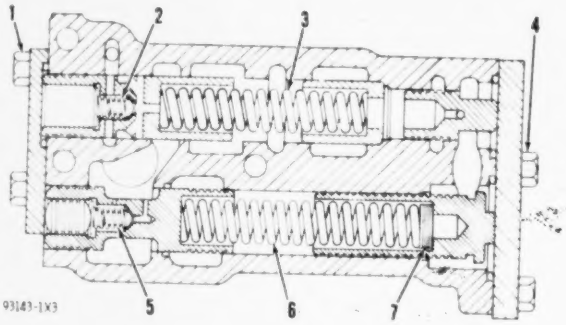
One spacer will change pressure .... 9.1 psi (0.64 kg/cm²)

5M9624 Spacer for modulation relief valve:

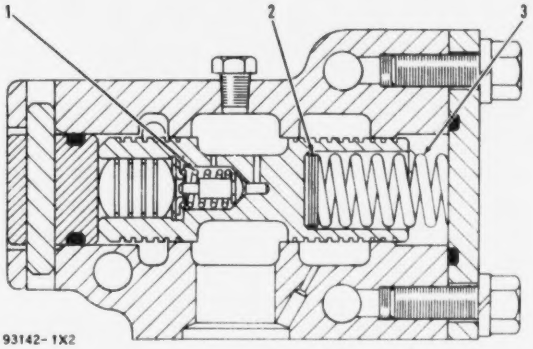
Thickness of spacer .... .010 in. (0.25 mm)

Outside diameter of spacer .... .812 in. (20.62 mm)

One spacer will change pressure .... 2.5 psi (0.18 kg/cm²)



PRIORITY VALVE
(POWER SHIFT)
(6P3554)



(1) 4M2381 Spring for plunger:

Length under test force .... .48 in. (12.2 mm)

Test force .... .517 ± .041 lb. (0.23 ± 0.02 kg)

Free length after test .... .89 in. (22.6 mm)

Outside diameter .... .300 in. (7.62 mm)

(2) 5M9624 Spacer:

Thickness of spacer .... .010 in. (0.25 mm)

Outside diameter of spacer .... .812 in. (20.62 mm)

One spacer will change pressure .... 11.2 psi (0.79 kg/cm²)

(3) 3P4053 Spring:

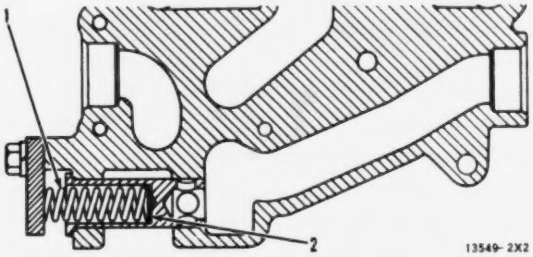
Length under test force .... 1.27 in. (32.3 mm)

Test force .... 119.5 ± 7.8 lb. (54.2 ± 3.5 kg)

Free length after test .... 1.62 in. (41.1 mm)

Outside diameter .... .750 in. (19.05 mm)

RELIEF VALVE FOR CONVERTER INLET
(POWER SHIFT)



(1) 8M8627 Spring:

Length under test force .... 2.11 in. (53.6 mm)

Test force .... 88.8 ± 7.1 lb. (40.3 ± 3.2 kg)

Free length after test .... 3.10 in. (78.7 mm)

Outside diameter .... .780 in. (19.81 mm)

(2) 5M3492 Spacer:

Thickness of spacer .... .010 in. (0.25 mm)

Outside diameter of spacer .... .750 in. (19.05 mm)

One spacer will change pressure ...... 2.5 psi (0.18 kg/cm²)

7M1397 Spacer:

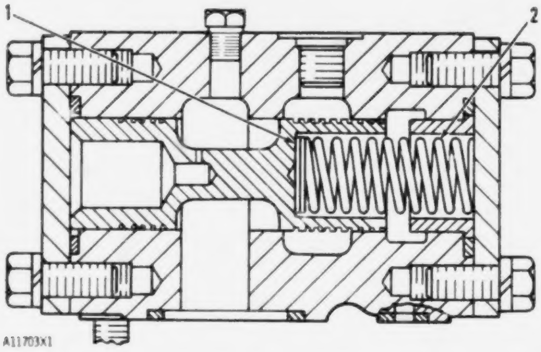
Thickness of spacer .... .036 in. (0.91 mm)

Outside diameter of spacer .... .750 in. (19.05 mm)

One spacer will change pressure ...... 9.0 psi (0.63 kg/cm²)

NOTE: FOR TORQUE VALUES NOT GIVEN, SEE THE FIRST PAGE OF SPECIFICATIONS FOR GENERAL TIGHTENING TORQUES

RELIEF VALVE FOR CONVERTER OUTLET
(POWER SHIFT)
(3P7665)



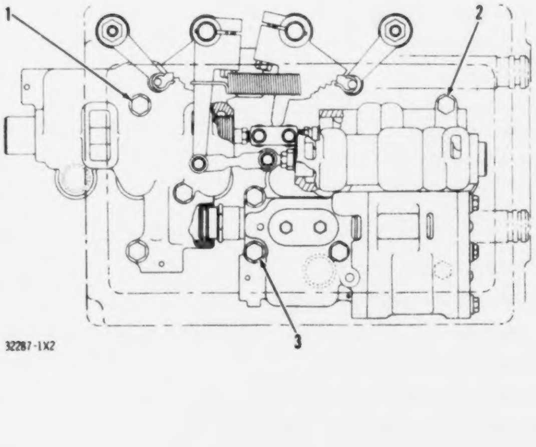
(1) 4B5270 Washer:

Thickness of washer	.083 ± .025 in. (2.11 ± 0.64 mm)
Outside diameter of washer	.88 in. (22.4 mm)
One washer will change pressure	2.7 psi (0.19 kg/cm²)

(2) 7M1297 Spring:

Length under test force	2.00 in. (50.8 mm)
Test force	39.54 ± 3.16 lb. (17.9 ± 1.4 kg)
Free length after test	2.98 in. (75.7 mm)
Outside diameter	.880 in. (22.35 mm)

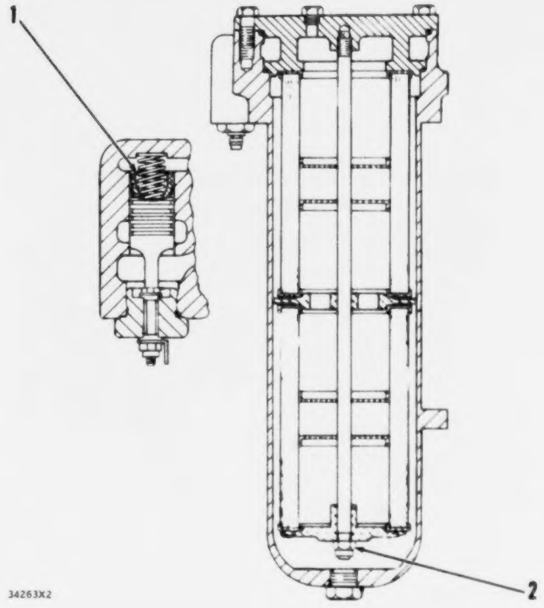
TRANSMISSION HYDRAULIC CONTROLS
(POWER SHIFT)



(1) Torque for the bolts that hold selector valve to transmission (three bolts)	35 ± 3 lb. ft. (4.8 ± 0.4 mkg)
(2) Torque for the bolts that hold safety and direction valve to transmission (three bolts)	35 ± 3 lb. ft. (4.8 ± 0.4 mkg)
(3) Torque for the bolts that hold pressure control valve to transmission (three bolts)	35 ± 3 lb. ft. (4.8 ± 0.4 mkg)

OIL FILTER

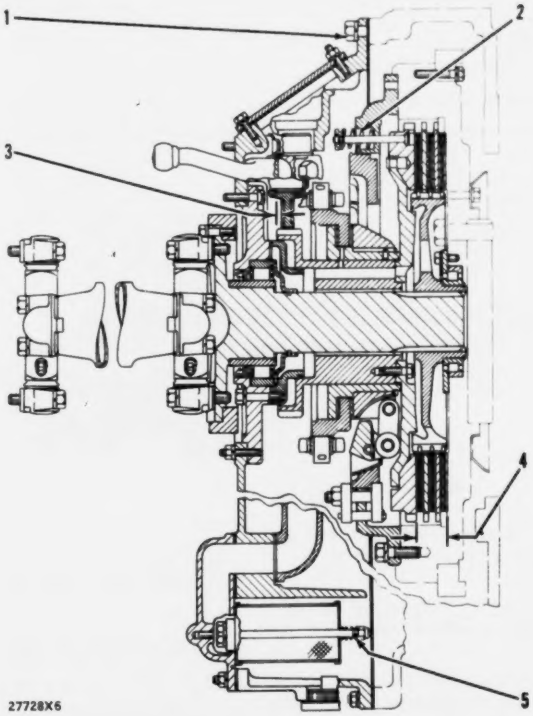
(3P4243)



	Bypass valve opens at approximately	25 psi (1.8 kg/cm^2)
(1)	2S5816 Spring:	
	Length under test force	1.35 in. (34.3 mm)
	Test force	12.2 ± .98 lb. (5.5 ± 0.4 kg)
	Free length after test	1.86 in. (47.2 mm)
	Outside diameter	.562 in. (14.27 mm)
(2)	Torque for the nut that holds the filter element in place	10 ± 2 lb.ft. (1.4 ± 0.3 mkg)

FLYWHEEL CLUTCH

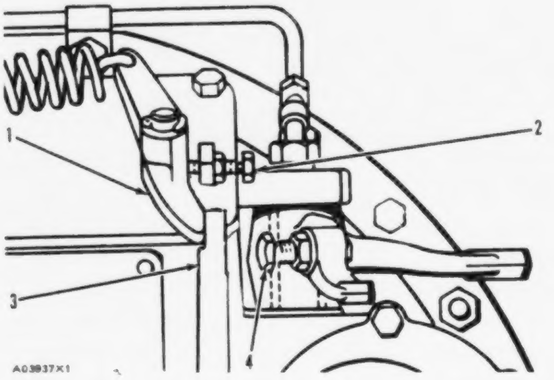
(DIRECT DRIVE)

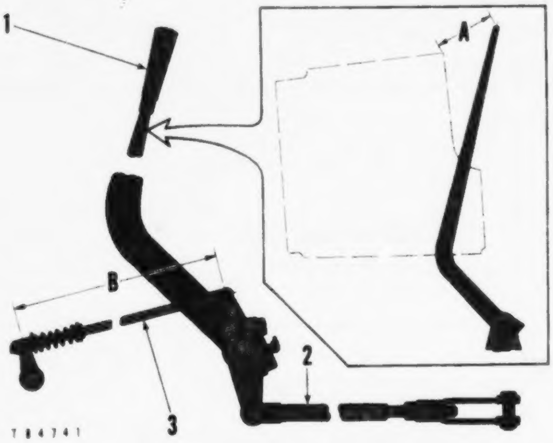


(1)	Torque for nuts (twelve)	85 ± 5 lb.ft. (11.8 ± 0.7 mkg)
(2)	1A7570 Springs (four):	
	Length under test force	2.00 in. (50.8 mm)
	Test force	29 to 34 lb. (13.2 to 15.4 kg)
	Free length after test	2.50 in. (63.5 mm)
	Outside diameter	.929 in. (23.60 mm)
(3)	End play of gear	.005 to .012 in. (0.13 to 0.31 mm)
(4)	Thickness of three new discs and two new plates	1.315 to 1.365 in. (33.40 to 34.67 mm)
	Thickness of one new disc	.275 to .285 in. (6.99 to 7.24 mm)
	Thickness of one new plate	.245 to .255 in. (6.22 to 6.48 mm)
(5)	4B7033 Spring:	
	Length under test force	.750 in. (19.05 mm)
	Test force	13.4 to 15.8 lb. (6.08 to 7.17 kg)
	Free length after test	1.00 in. (25.4 mm)
	Outside diameter	.582 in. (14.78 mm)
	Torque for nut that holds the gear on the oil pump shaft	40 ± 4 lb.ft. (5.5 ± 0.6 mkg)

NOTE: FOR TORQUE VALUES NOT GIVEN, SEE THE FIRST PAGE OF SPECIFICATIONS FOR GENERAL TIGHTENING TORQUES

ADJUSTMENTS FOR THE FLYWHEEL CLUTCH



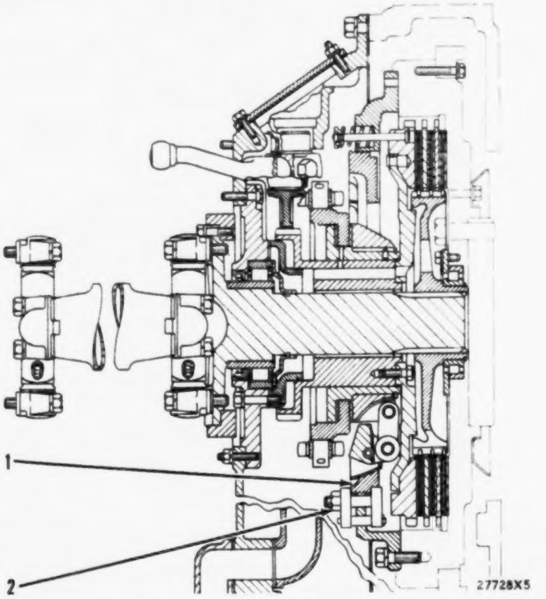


ADJUSTMENT OF BRAKE

1. Move the clutch control lever to the ENGAGED position.
2. Loosen the nut on screw (4) and turn the screw clockwise as far as possible.
3. Loosen the nut on screw (2) and turn the screw clockwise until there is a small amount of clearance between levers (1) and (3) when lever (3) is pushed as far as possible toward lever (1) (to put the brake lining against the brake drum).
4. Turn screw (2) counterclockwise until lever (1) makes contact with lever (3). Then turn screw (2) counterclockwise another one half turn. Tighten the nut that holds it.
5. Put the clutch in the NOT ENGAGED position.
6. Move the clutch control lever as far forward as possible. Then release the clutch control lever.
7. Move lever (3) and hold it against lever (1). Turn screw (4) counterclockwise until the screw is in contact with lever (3). Tighten the nut that holds it.

ADJUSTMENT OF CONTROL LINKAGE

1. Move clutch control lever (1) to the ENGAGED position.
2. Make an adjustment to the length of clutch control rod (2) until dimension (A) between end of rod and seat is .... 6.81 in. (173.0 mm)
3. Make an adjustment to the length of interlock control rod (3) until dimension (B) is .... 15.44 in. (392.2 mm)



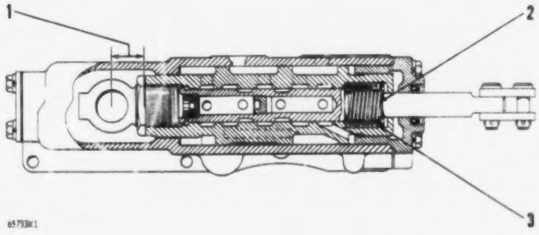
ADJUSTMENT OF FLYWHEEL CLUTCH

1. Loosen nut (2) approximately two turns and make sure the retainer plate is free on the stud.
2. Turn the flywheel 180° and loosen the other nut and plate.
3. Fasten a spring scale at the bottom of the handle for the clutch control lever.
4. Turn adjustment ring (1) clockwise (for an increase) or counterclockwise (for a decrease) until the amount of force needed on spring scale to engage the clutch is .... 175 ± 5 lb. (79.4 ± 2.3 kg)
5. Tighten nuts (2) to a torque of .... 75 ± 10 lb.ft. (10.4 ± 1.4 mkg)

CONTROL MECHANISM FOR THE FLYWHEEL CLUTCH

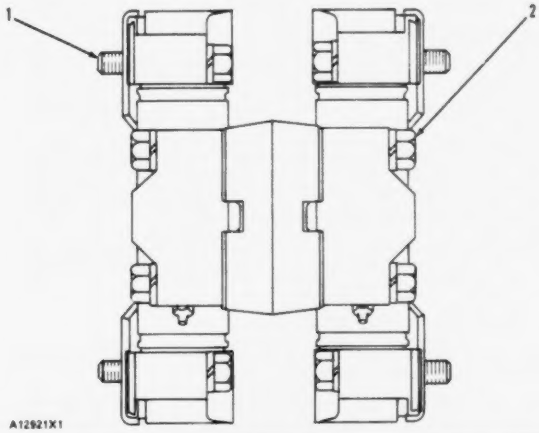
(DIRECT DRIVE)
(5S4802)

(1)	Distance from the center of the coupling to the face of the piston	1.28 ± .03 in. (32.5 ± 0.8 mm)
(2)	1A8312 Spring:	
	Length under test force	1.25 in. (31.8 mm)
	Test force	11 to 12 lb. (5.0 to 5.4 kg)
	Free length after test	2.219 in. (56.36 mm)
	Outside diameter	1.167 in. (29.64 mm)
(3)	1A2180 Spring:	
	Length under test force	1.25 in. (31.8 mm)
	Test force	55 to 65 lb. (24.9 to 29.5 kg)
	Free length after test	2.594 in. (65.89 mm)
	Outside diameter	1.640 in. (41.66 mm)



UNIVERSAL JOINT

(POWER SHIFT)

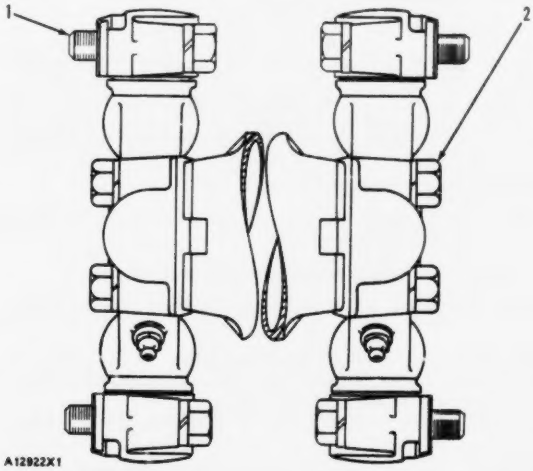


A12921X1

(1)	Torque for the bolts	100 ± 5 lb.ft. (13.8 ± 0.7 mkg)
(2)	Torque for bolts	120±5 lb.ft. (16.6±0.7 mkg)

UNIVERSAL JOINT

(DIRECT DRIVE)



A12922X1

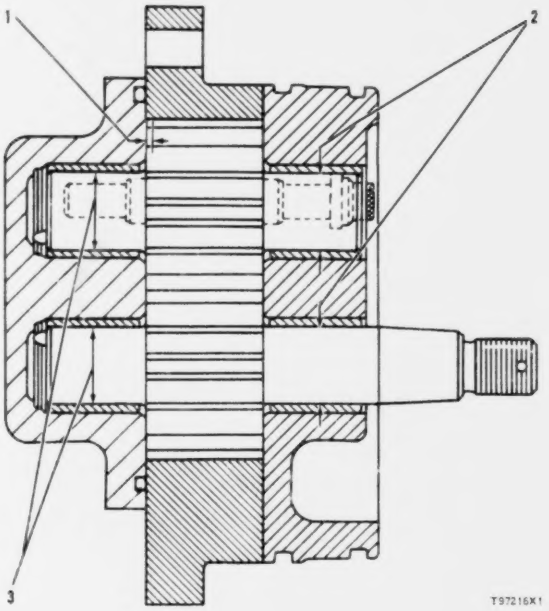
(1)	Torque for the bolts	100 ± 10 lb.ft. (13.8 ± 1.4 mkg)
(2)	Torque for bolts	100±10 lb.ft. (13.8±1.4 mkg)

NOTE: FOR TORQUE VALUES NOT GIVEN, SEE THE FIRST PAGE OF SPECIFICATIONS FOR GENERAL TIGHTENING TORQUES

OIL PUMP FOR THE FLYWHEEL CLUTCH

(DIRECT DRIVE)

(4S9003)



Rotation (seen from drive end) .... Clockwise

Output .... 24.7 U.S. gpm (93.5 lit/min)

at a pump speed of .... 2800 rpm

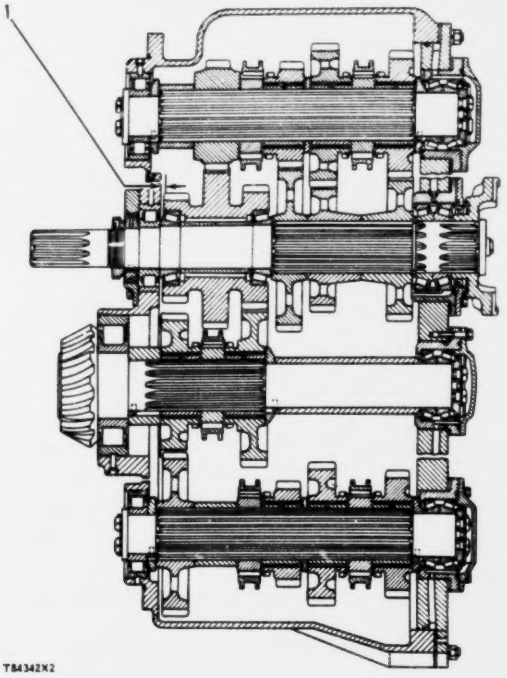
at a pressure of .... 350 psi (24.6 kg/cm²)

(1) Clearance between the gears and the cover .... .0019 to .0035 in. (0.048 to 0.089 mm)

(2) Diameter of the shafts .... .8745 to .8749 in. (22.212 to 22.222 mm)

(3) Bore of the bearings .... .8760 to .8766 in. (22.250 to 22.266 mm)

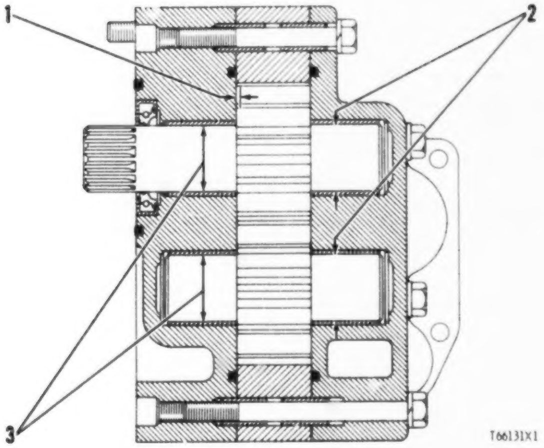
DIRECT DRIVE TRANSMISSION



(1) Preload for the bearings of the idler gear .... .007 in. (0.18 mm)

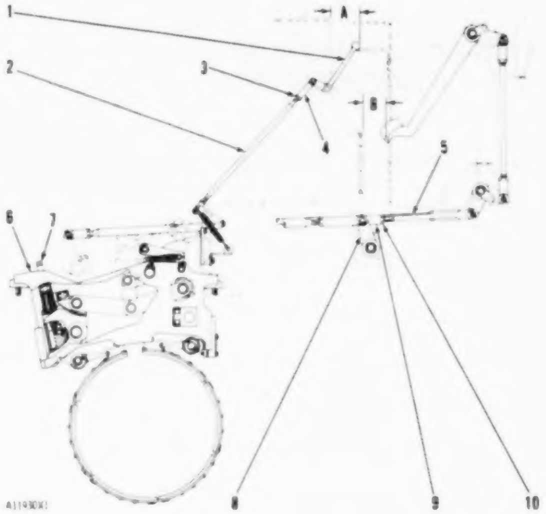
OIL PUMP FOR DIRECT DRIVE TRANSMISSION

(3P6293)



	Rotation as seen from drive end	Clockwise
	Output	25.2 U.S. gpm (95.4 lit/min)
	At a pump speed of	1883 rpm
	At a pressure of	350 psi (24.6 kg/cm^2)
(1)	Clearance between the gears and cover (new)	.0025 ± .0006 in. (0.064 ± 0.015 mm)
(2)	Diameter of shafts (new)	1.2497 ± .002 in. (31.742 ± 0.005 mm)
(3)	Bore of bearings (new)	1.2514 ± .0003 in. (31.786 ± 0.008 mm)

ADJUSTMENTS FOR THE BRAKES



ADJUSTMENT OF THE BRAKES

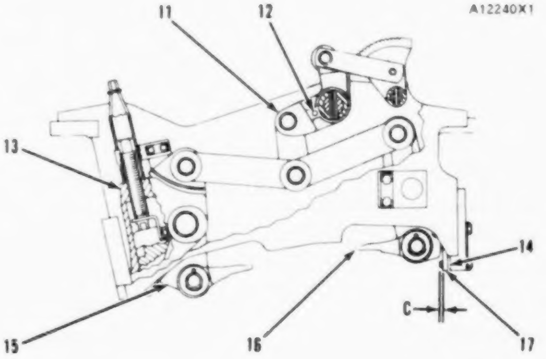
1. Install support assembly (6), booster housings and the levers that are fastened to the housings.
2. Turn socket (7) clockwise until the brake band is tight on the brake drum. Then turn socket (7) counterclockwise 1 1/2 turns or nine clicks (the noise heard when a detent is felt).
3. Install the remainder of the brake linkage.
4. Remove the cotter pin and pin that connects rod end (9) to lever (8). Loosen nut (10). Make an adjustment to the length of rod (5) so distance (B) between front of the right brake pedal and the bottom front of the seat frame is .... 18.66 ± .12 in. (474.0 ± 3.1 mm)
5. Tighten nut (10). Put rod end (9) in position on lever (8) and install pin and cotter pin.
6. Make an adjustment to the control rod for the left brake so the left brake pedal is in alignment with the right brake pedal.

ADJUSTMENT OF THE PARKING BRAKE LEVER

1. Put lever (1) in the NOT ENGAGED position.
2. Remove cotter pin and pin that connect rod end (4) to lever (1). Loosen nut (3). Make an adjustment to the length of rod (2) so distance (A) between the seat frame and the end of lever (1) is .... 3.50 ± .06 in. (88.9 ± 1.5 mm)

NOTE: If the machine has a hydraulic control console, make the adjustment so the distance between the end of the lever (10) and the edge of the hydraulic control console is .... 4.06 ± .02 in. (103.1 ± 0.5 mm)

3. Tighten nut (3). Put rod end (4) in position on lever (1) and install pin and the cotter pin.

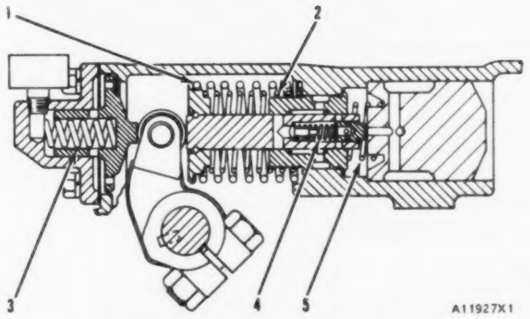


ADJUSTMENT OF THE MECHANISM OF BRAKE ENGAGEMENT

If the mechanism has been assembled with new parts or shims (14) behind plate (17) have been lost, make the adjustment that follows:

1. Install a .375 in. (9.53 mm) diameter rod through the holes in support assembly (6) and bellcrank (11).
2. Hold lever assembly (13) against the back plate of the support assembly.
3. Hold lever assemblies (15) and (16) apart to remove movement (slack) in the linkage.
4. Measure distance (C) between lever assembly (16) and plate (17) with a feeler gauge. Distance must be .... .010 ± .005 in. (0.25 ± 0.13 mm)
5. Add or remove shims (14) between plate and support assembly to get correct distance (A).
6. Remove the rod from the holes.
7. See "Adjustment of Brakes" and "Adjustment of Parking Brake Lever".

HYDRAULIC CONTROL MECHANISM FOR THE BRAKES



(1) 9H7534 Spring:

Length under test force .... 2.688 in. (68.28 mm)

Test force .... 33 ± 1.6 lb. (15 ± 0.7 kg)

Free length after test .... 4.39 in. (111.5 mm)

Outside diameter .... 2.54 in. (64.5 mm)

(2) 9H7553 Spring:

Length under test force .... 2.438 in. (61.93 mm)

Test force .... 16.4 ± .8 lb. (7.4 ± 0.36 kg)

Free length after test .... 3.95 in. (100.3 mm)

Outside diameter .... 2.08 in. (52.8 mm)

(3) 5B2547 Spring:

Length under test force .... 1.875 in. (47.63 mm)

Test force .... 206 to 241 lb. (93.5 to 109.4 kg)

Free length after test .... 2.219 in. (56.36 mm)

Outside diameter .... .715 in. (18.16 mm)

(4) 1B9061 Spring:

Length under test force .... .875 in. (22.23 mm)

Test force .... 1.4 to 1.8 lb. (0.64 to 0.82 kg)

Free length after test .... 1.375 in. (34.93 mm)

Outside diameter .... .329 in. (8.36 mm)

(5) 7J2025 Spring:

Length under test force .... 1.25 in. (31.8 mm)

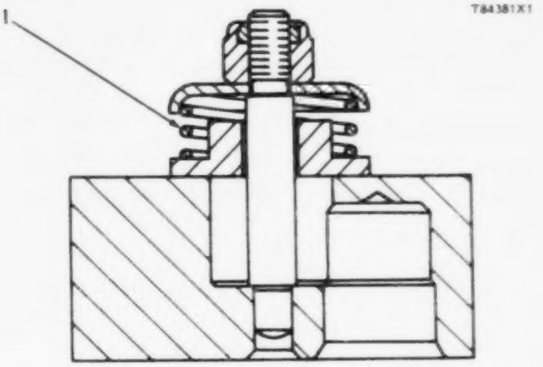
Test force .... 30.5 ± 2.1 lb. (13.8 ± 0.95 kg)

Free length after test .... 2.38 in. (60.5 mm)

Outside diameter .... 1.500 ± .025 in. (38.10 ± 0.64 mm)

]

RELIEF VALVE FOR BRAKE COOLING AND LUBRICATION



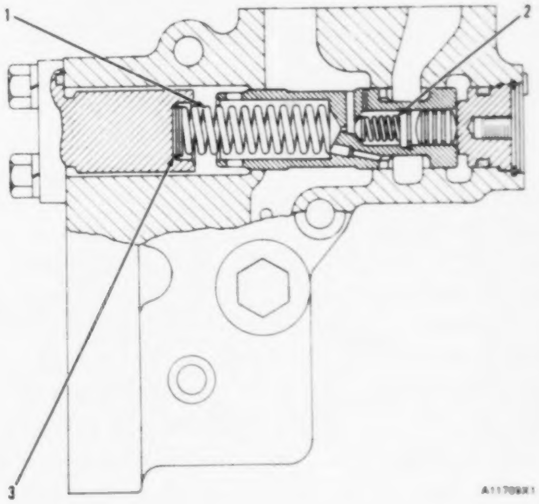
(1) 1S7139 Spring:

Length under test force	.590 in. (14.99 mm)
Test force	60 ± 3 lb. (27.2 ± 1.4 kg)
Free length after test	890 in. (22.61 mm)
Outside diameter	1.50 in. (38.1 mm)

RELIEF VALVE FOR THE HYDRAULIC CONTROLS FOR THE STEERING CLUTCHES AND BRAKES

(DIRECT DRIVE)

(3P3319)



(1) 8M8627 Spring:

Length under test force	2.11 in. (53.6 mm)
Test force	88.8 ± 7.1 lb. (40.32 ± 3.22 kg)
Free length after test	3.10 in. (78.7 mm)
Outside diameter	.780 in. (19.81 mm)

(2) 4M2381 Spring:

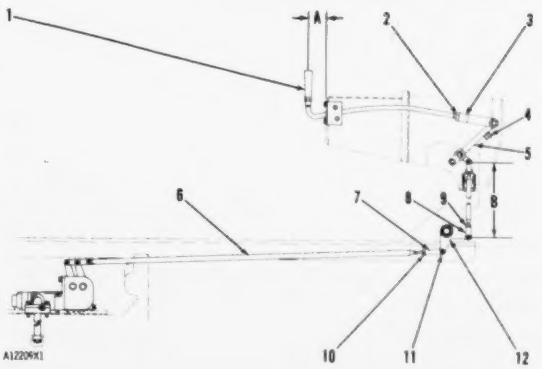
Length under test force	.48 in. (12.2 mm)
Test force	.517 ± .04 lb. (0.2347 ± 0.018 kg)
Free length after test	.89 in. (22.6 mm)
Outside diameter	.300 in. (7.62 mm)

(3) 5M3492 Spacers:

Thickness of spacer	.010 in. (0.25 mm)
Outside diameter of spacer	.750 in. (19.05 mm)
One spacer will change pressure	4.3 psi (0.3 kg/cm^2)

ADJUSTMENT OF THE CONTROL LINKAGE FOR THE STEERING CLUTCH

1. Loosen nuts (2).
2. Remove cotter pins and pins that connect rod ends (3) to levers (5).
3. Push levers (5) all the way toward the front of the machine against bumpers (4).
4. Make an adjustment to rod ends (3) so distance (A) between the centerline of handles (1) and the face of the dash is .... 2.50 ± .12 in. (63.5 ± 3.1 mm).
5. Install the pins and cotter pins that connect rod ends (3) to levers (5).
6. Tighten nuts (2) against rod ends (3).
7. Loosen nuts (9).
8. Remove the cotter pins and pins that connect rod ends (8) to levers (12).
9. Make an adjustment to rod ends (8) so the length of the rods is changed until distance (B) between the centerline of the pins is .... 18.50 ± .12 in. (469.9 ± 3.1 mm).
10. Install the pins and cotter pins that connect rod ends (8) to levers (12).
11. Tighten nuts (9).
12. Loosen nuts (10).
13. Remove the cotter pins and pins (11) that connect rod ends (7) to levers (12).
14. Pull rods (6), one at a time, toward the front of the machine until a resistance is felt.
15. Make an adjustment to rod ends (7), one at a time, so pins (11) can be installed through the rod ends into levers (12).
16. Turn rod ends (7), one at a time, 1/2 turn so the length of rods (6) is made shorter.
17. Put rod ends (7) in position on levers (12) and install pins (11) and cotter pins.
18. Tighten nuts (10).



VALVE GROUP FOR CONTROL OF THE STEERING CLUTCHES

(1) 5J4698 Spring:

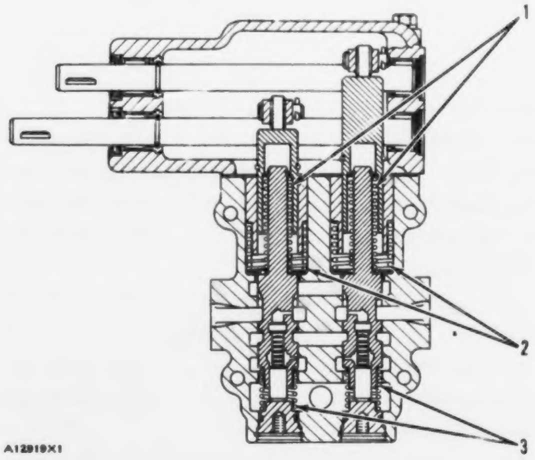
Length under test force	2.62 in. (66.5 mm)
Test force	23.4 ± 1.9 lb. (10.6 ± 0.86 kg)
Free length after test	2.88 in. (73.2 mm)
Outside diameter	.812 in. (20.62 mm)

(2) 8S5753 Spring:

Length under test force	1.375 in. (34.93 mm)
Test force	40 ± 2 lb. (18.2 ± 0.91 kg)
Free length after test	2.79 in. (70.9 mm)
Outside diameter	1.690 in. (42.93 mm)

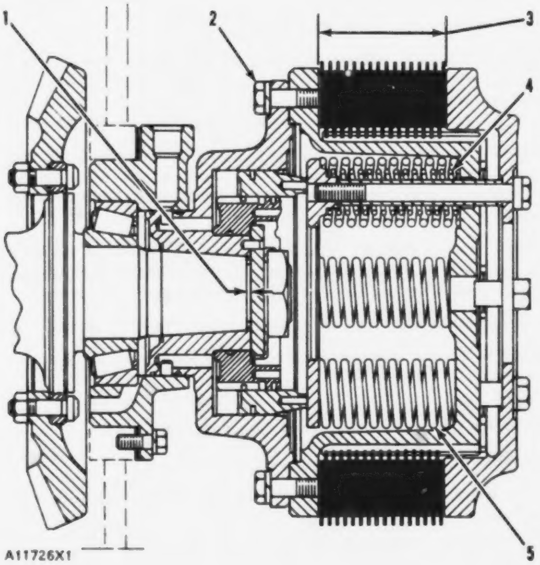
(3) 2S8398 Spring:

Length under test force	1.08 in. (27.4 mm)
Test force	12 ± .6 lb. (5.5 ± 0.27 kg)
Free length after test	2.10 in. (53.3 mm)
Outside diameter	.972 in. (24.69 mm)



NOTE: FOR TORQUE VALUES NOT GIVEN, SEE THE FIRST PAGE OF SPECIFICATIONS FOR GENERAL TIGHTENING TORQUES

STEERING CLUTCHES



(1) Distance between the face of the hub and the shoulder of the shaft must be .... .125 ± .031 in. (3.18 ± 0.79 mm)

After the hub has been pushed onto the shaft with a pressure of .... 35 to 40 ton (31.8 to 36.3 t)

(2) Torque for bolts .... 200 ± 20 lb.ft. (27.7 ± 2.8 mkg)

(3) Thickness of sixteen new disc assemblies and fifteen new discs .... 4.108 to 4.542 in. (104.34 to 115.37 mm)

Thickness of one new 1P6996 Disc Assembly .... .178 to .192 in. (4.52 to 4.88 mm)

Thickness of one new 8F4453 Disc .... .084 to .098 in. (2.13 to 2.49 mm)

(4) 4H6917 Springs (inner):

Length under test force .... 4.563 in. (115.90 mm)

Test force .... 192 to 224 lb. (87.1 to 101.6 kg)

Free length after test .... 7.563 in. (192.10 mm)

Outside diameter .... 1.656 in. (42.06 mm)

(5) 1M4593 Springs (outer):

Length under test force .... 5.014 in. (127.36 mm)

Test force .... 332 to 367 lb. (150.6 to 166.5 kg)

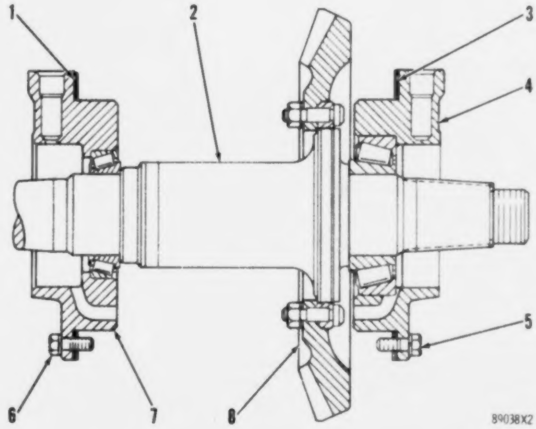
Free length after test .... 8.21 in. (208.5 mm)

Outside diameter .... 2.438 in. (61.93 mm)

BEVEL GEAR AND PINION
(POWER SHIFT)

ADJUSTMENT OF THE BEARINGS FOR THE BEVEL GEAR SHAFT

1. Install bevel gear shaft (2) in the machine without bevel gear (8), if the transmission is installed in the machine. Install bevel gear shaft (2) with bevel gear (8) if the transmission is not installed.
2. Install bearing cage (4) with a full package of shims (3). Tighten bolts (5), without the lockwashers, evenly. The thickness of a full shim pack is .... .119 to .125 in. (3.02 to 3.18 mm)
3. Install bearing cage (7) without shims (1).
4. Tighten bolts (6), without the lockwashers, evenly while slowly turning bevel gear shaft (2) until the torque needed to turn the bevel gear shaft is .... 60 to 80 lb.in. (69.2 to 92.2 cm.kg)
5. Measure the distance between the flange of bearing cage (7) and the face of the bevel gear case with a feeler gauge. Measure the distance at each of the bolts around bearing cage (7). Make sure the distance is the same at each of the bolts.
6. Remove bearing cage (7). Install an amount of shims (1) the same thickness as the distance measured in Step 5. Install bearing cage (7) and bolts (6) with the lockwashers. Tighten bolts (6) evenly.
7. Install bolts (5) with the lockwashers. Tighten the bolts evenly.
8. Check the torque that is needed to turn bevel gear shaft (2) again. The torque must be .... 60 to 80 lb.in. (69.2 to 92.2 cm.kg)



ADJUSTMENT OF THE FREE MOVEMENT (BACKLASH)

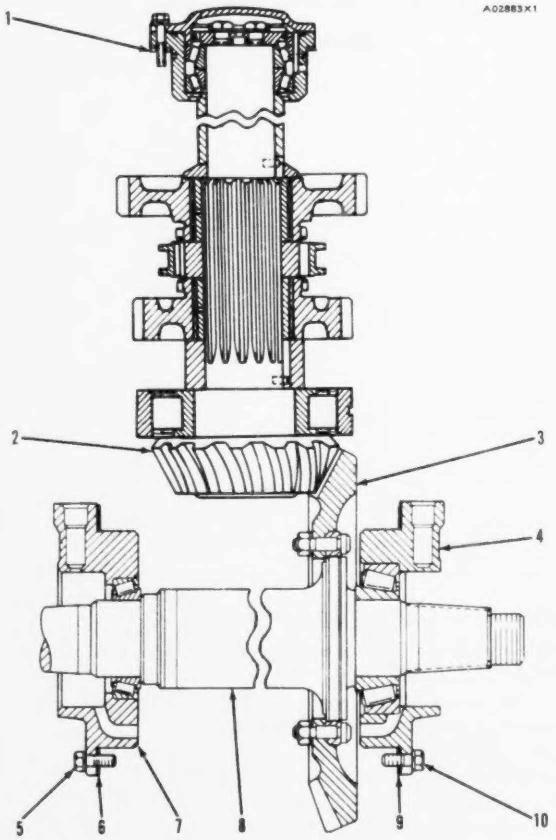
1. Install the transmission or bevel gear (8).
2. Install a dial indicator so the indicator tip is on one tooth of the bevel pinion.
3. Put a block of wood between bevel gear (8) and the case so the bevel gear does not turn.
4. Push the bevel pinion toward the front of the machine as far as possible. Move the bevel pinion clockwise and then counterclockwise. The free movement (backlash) will be the difference in the values read on the dial indicator.
5. Measure the backlash at four points around the bevel gear to find the point of the smallest backlash.

NOTE: Make sure the bevel pinion is held as far as possible toward the front of the machine when the backlash is measured.

6. The correct backlash is .... .025 + .004 or - .003 in. (0.64 + 0.10 or - 0.08 mm)
7. If the measurement of the smallest backlash is too large, remove some of shims (3) from behind bearing cage (4). Install the shims (that were removed) behind bearing cage (7).
8. If the measurement of the smallest backlash is too small remove some of shims (1) from behind bearing cage (7). Install the shims (that were removed) behind bearing cage (4).

NOTE: The adjustment of the bearings for bevel gear shaft (2) will not change by the movement of shims from one bearing cage to the other bearing cage as long as the total thickness of shims is the same.

BEVEL GEAR AND PINION
(DIRECT DRIVE)



ADJUSTMENT OF THE BEARINGS FOR THE BEVEL GEAR SHAFT

1. Install bevel gear shaft (8) in the machine without bevel gear (3), if the transmission is installed in the machine. Install bevel gear shaft (8) in the machine with the bevel gear (3) if the transmission is not installed.
2. Install bearing cage (4) with a full package of shims (9). Tighten bolts (10) without the lockwashers evenly. The thickness of a full shim pack is . . . . .119 to .125 in. (3.02 to 3.18 mm)
3. Install bearing cage (7) without shims (6).
4. While slowly turning bevel gear shaft (8), tighten bolts (5), without the lockwashers, evenly until the torque needed to turn the bevel gear shaft is . . . . 60 to 80 lb.in. (69.2 to 92.2 cm.kg)
5. Measure the distance between the flange of bearing cage (7) and the face of the bevel gear case with a feeler gauge. Measure the distance at each of the bolts around bearing cage (7). Make sure the distance is the same at each of the bolts.
6. Remove bearing cage (7). Install an amount of shims (6) the same thickness as the distance measured in Step 5. Install bearing cage (7) and bolts (5) with the lockwashers. Tighten bolts (5) evenly.
7. Install bolts (10) with the lockwashers. Tighten the bolts evenly.
8. Check the torque that is needed to turn bevel gear shaft (8) again. The torque must be . . . . 60 to 80 lb.in. (69.2 to 92.2 cm.kg)

ADJUSTMENT OF THE FREE MOVEMENT (BACKLASH)

1. Install the transmission or bevel gear (3).
2. Install a dial indicator so the indicator tip is on one tooth of bevel pinion (2).
3. Put a block of wood between bevel gear (3) and the case so the bevel gear does not turn.
4. Move bevel pinion (2) clockwise and then counterclockwise. The free movement (backlash) will be the difference in the values read on the dial indicator.
5. Measure the backlash at four points around the bevel gear to find the point of smallest backlash.
6. The correct amount of backlash between the bevel gear and pinion is . . . . .0115 + .004 or - .003 in. (0.29 + 0.10 or - 0.08 mm)
7. If the measurement of the smallest backlash is too large, remove some of shims (9) from behind bearing cage (4). Install the shims (that were removed) behind bearing cage (7).
8. If the measurement of the smallest backlash is too small, remove some of shims (6) from behind bearing cage (7). Install the shims (that were removed) behind bearing cage (4).

NOTE: The adjustment of the bearings for bevel gear shaft (8) will not change by the movement of shims from one bearing cage to the other as long as the total thickness of shims is the same.

Bevel Gear and Pinion (Cont.)

(Direct Drive)

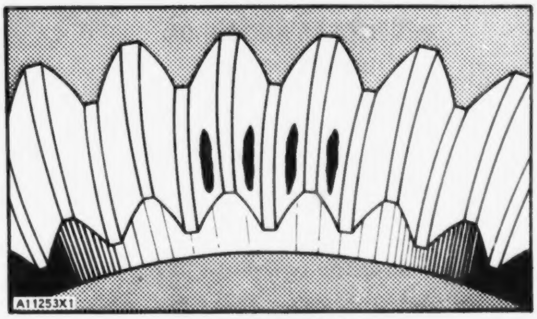


ILLUSTRATION A

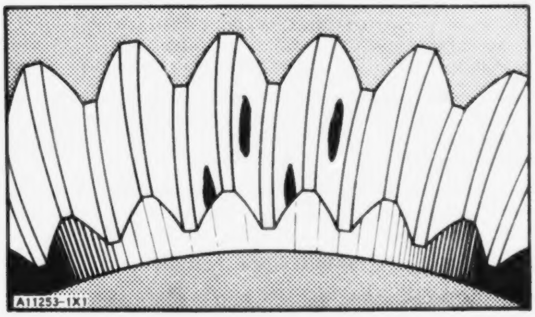


ILLUSTRATION B

ADJUSTMENT OF TOOTH CONTACT PATTERN

1. Put a small amount of Prussian blue, red lead, or paint on the ring gear teeth.
2. Turn the pinion (2) counterclockwise and then clockwise. Check the marks made on the teeth of ring gear (3).
3. If the marks made on the teeth of the ring gear look like the marks in Illustration A, the tooth contact is correct.
4. If the marks made on the teeth of the ring gear look like the marks in Illustration B, do the following:
   a. Remove some of shims (1) between the bearing cage and the transmission case.
   b. Do Steps 1 and 2 again.
5. If the marks made on the teeth of the ring gear look like the marks in Illustration C, do the following:
   a. Add to the amount of shims (1) between the bearing cage and the transmission case.
   b. Do Steps 1 and 2 again.

NOTE: Several adjustments may be necessary before getting the correct tooth contact. Make sure the free movement (backlash) is correct before the tooth contact is checked. A change in the free movement (backlash) will give a change in the tooth contact. A change in the tooth contact will give a change in the free movement (backlash).

6. After getting the correct tooth contact, remove the Prussian blue, read lead, or paint from the gears.

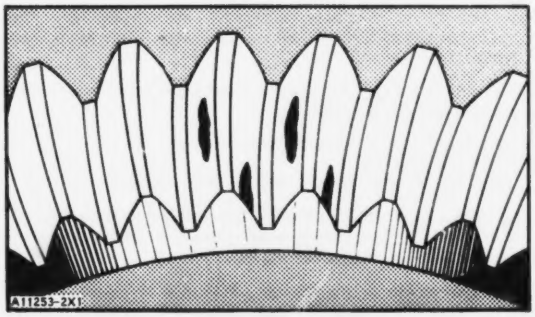
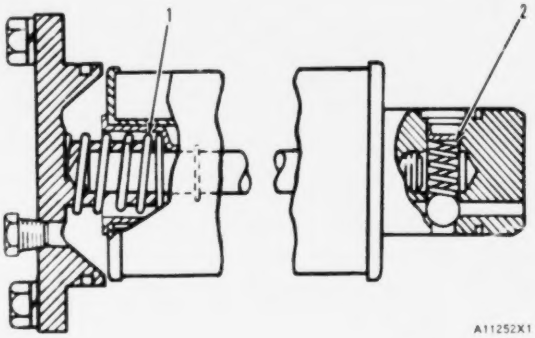


ILLUSTRATION C

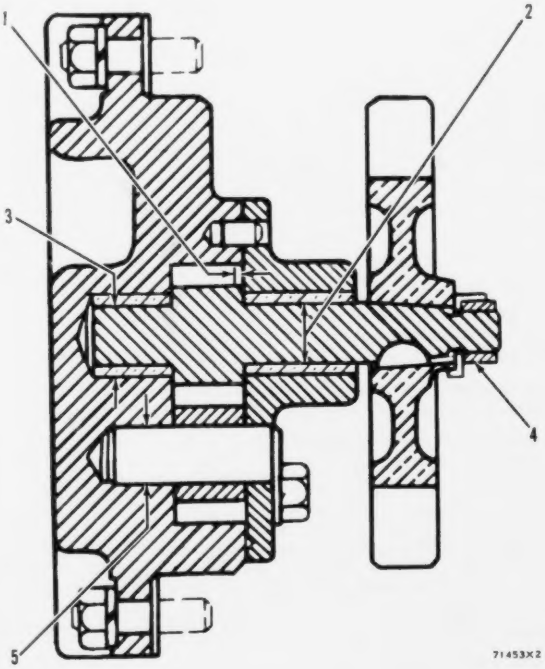
NOTE: FOR TORQUE VALUES NOT GIVEN, SEE THE FIRST PAGE OF SPECIFICATIONS FOR GENERAL TIGHTENING TORQUES

OIL FILTERS FOR THE FINAL DRIVES



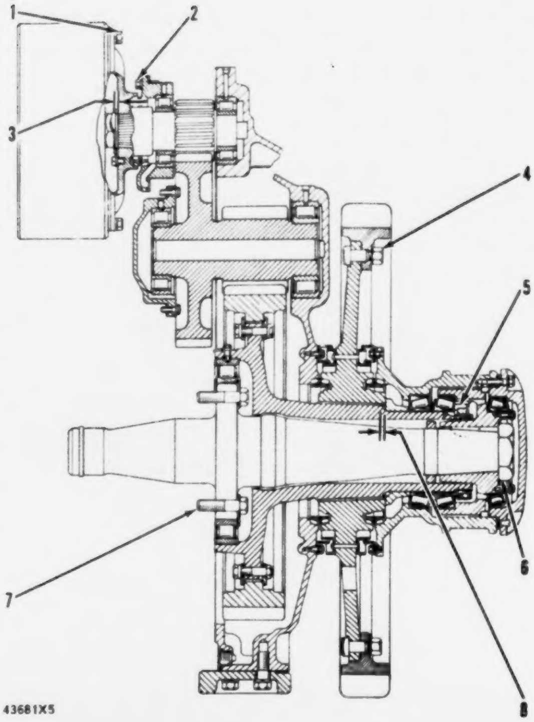
(1)	1H4769 Spring:	
	Length under test force	1.375 in. (34.93 mm)
	Test force	27.4 ± 2.2 lb. (27.85 ± 0.98 kg)
	Free length after test	2.00 ± .04 in. (50.8 ± 1.0 mm)
	Outside diameter	1.194 to 1.226 in. (30.33 to 31.14 mm)
(2)	9F6705 Spring:	
	Length under test force	.906 in. (23.01 mm)
	Test force	2.35 to 2.75 lb. (1.067 to 1.249 kg)
	Free length after test	1.938 in. (49.23 mm)
	Outside diameter	.438 in. (11.13 mm)

OIL PUMP FOR THE FINAL DRIVES
(5H1719)



	Rotation as seen from the drive end	Counterclockwise
	Output	3.0 U.S. gpm (11.4 lit/min)
	At a pump speed of	970 rpm
	At a pressure of	50 psi (3.5 kg/cm^2)
(1)	Clearance between the gears and the cover (new)	.002 to .004 in. (0.05 to 0.10 mm)
(2)	Bore of the bearings (new)	.6185 to .6191 in. (15.710 to 15.725 mm)
(3)	Diameter of the drive shaft (new)	.6165 to .6171 in. (15.659 to 15.674 mm)
(4)	Torque for nut	25 ± 5 lb.ft. (3.5 ± 0.7 mkg)
(5)	Diameter of the idler shaft (new)	.6195 to .6200 in. (15.735 to 15.748 mm)

FINAL DRIVES



(1) Torque for bolts (with 4S9416 Anti-Seize Compound on threads) .... 200 ± 20 lb.ft. (27.7 ± 2.8 mkg)

(2) Torque for bolts (tighten by hand) .... 100 ± 10 lb.ft. (13.8 ± 1.4 mkg)

(3) Distance between the face of the flange and the shoulder of pinion shaft .... .12 ± .03 in. (3.0 ± 0.8 mm)

After the pinion has been pushed into the flange with a force of .... 35 to 40 ton (31.8 to 36.3 t)

(4) Torque for nuts that hold sprocket segments to sprocket hub .... 250 ± 50 lb.ft. (34.6 ± 6.9 mkg)

Then turn an additional .... 120°

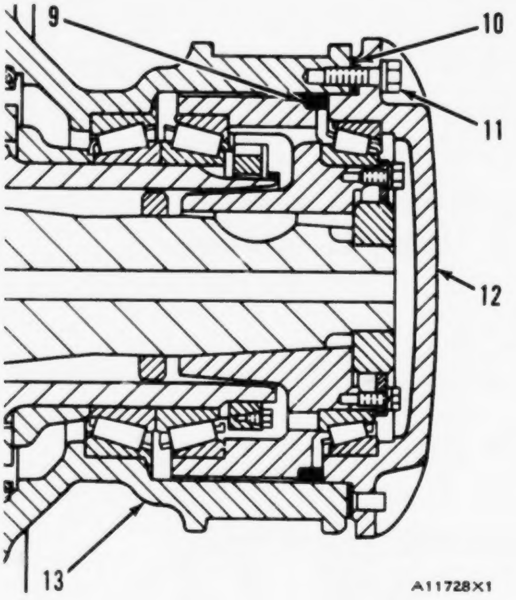
(5) Tighten nut until the two bearing cones are against each other. Then tighten or loosen nut until the holes in the lock are in alignment with the holes in the nut. The minimum torque on the nut must be .... 500 lb.ft. (69.2 mkg)

(6) Tighten nut to a torque of .... 1350 ± 135 lb.ft. (186.7 ± 18.7 mkg)

Then tighten or loosen nut until the holes in the lock and bearing cage are in alignment when the lock is installed.

(7) Torque for eight bolts (tighten by hand) .... 550 ± 55 lb.ft. (76.1 ± 7.6 mkg)

Final Drives (Cont.)



(8) Distance between the face of the sprocket and spline shoulder of the hub .... .25 ± .06 in. (6.4 ± 1.5 mm)

After the sprocket has been pushed on the hub with a force of .... 60 to 65 ton (54.4 to 59.0 t)

Torque for the bolts that hold final drive cases to bevel gear and steering clutch case (tighten by hand) .... 200 ± 20 lb.ft. (27.7 ± 2.8 mkg)

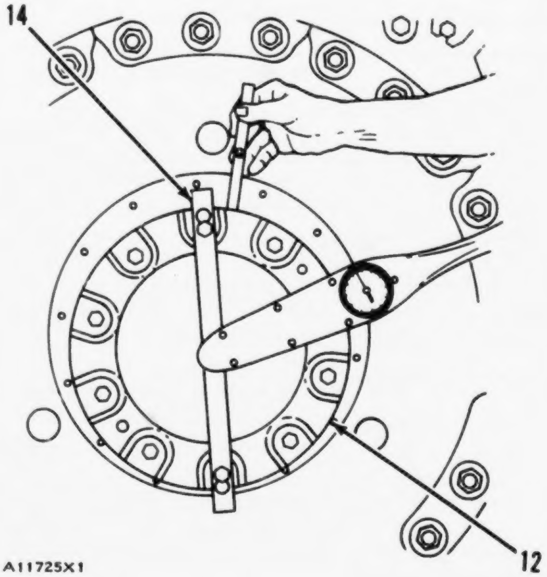
NOTE: Rubber toric seals and all surfaces in contact with them must be clean and dry at assembly. Put a thin layer of oil on the surfaces of the metal seals that are in contact just before installation.

ADJUSTMENT OF THE BEARINGS FOR THE FINAL DRIVES

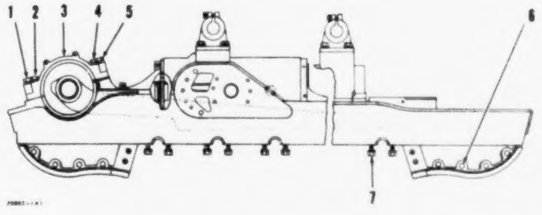
1. Install cap (12) without cork seal (9) and shims (10).
2. Turn the sprocket a minimum of eight complete revolutions and support (13) a minimum of four complete revolutions.
3. Install 5T520 Adapter (14) on the cap.
4. While slowly turning support (13), tighten bolts (11) evenly until the torque that is needed to turn the support is .... 50 ± 3 lb.ft. (6.9 ± 0.4 mkg)

NOTE: Make sure the sprocket does not turn.

5. Measure the distance between cap (12) and the face of the support with a feeler gauge.
6. Remove cap (12) and FT520 Adapter.
7. Install cork seal (9).
8. Install an amount of shims (10) the same thickness as the distance measure in Step 6.
9. Install cap (12) and bolts (11).
10. Measure the torque that is needed to turn the support. The torque must be .... 50 ± 3 lb.ft. (6.9 ± 0.4 mkg)



TRACK ROLLER FRAMES



(6) Torque for bolts that hold strip
to guard .... 600 ± 60 lb.ft. (83.0 ± 8.3 mkg)

(7) Torque for bolts that hold track rollers
to frame .... 800 ± 100 lb.ft. (110.6 ± 13.8 mkg)

ASSEMBLY PROCEDURE FOR RIGHT SIDE FRAME

1. Install two rear bolts (1) and (2). Tighten the bolts
to a torque of .... 960 ± 80 lb.ft. (132.8 ± 11.1 mkg)
2. Install bolt (4) and tighten to a
torque of .... 960 ± 80 lb.ft. (132.8 ± 11.1 mkg)
3. Use a feeler gauge and measure the distance between the faces of cap (3) and frame. Make the measurement at the front of the cap.
4. Remove bolt (4). Install an amount of shims the same thickness as the measurement in Step 3 plus
or minus .... .002 in. (0.05 mm)
5. Install two front bolts (4) and (5). Tighten the bolts to
a torque of .... 960 ± 80 lb.ft. (132.8 ± 11.1 mkg)

ASSEMBLY PROCEDURE FOR LEFT SIDE FRAME

1. Install two front bolts (4) and (5). Tighten the bolts
to a torque of .... 960 ± 80 lb.ft. (132.8 ± 11.1 mkg)
2. Install bolt (2). Tighten the bolt to
a torque of .... 960 ± 80 lb.ft. (132.8 ± 11.1 mkg)
3. Use a feeler gauge and measure the distance between the faces of cap (3) and the frame. Make the measurement at the rear of the cap.
4. Remove bolt (2). Install an amount of shims the same thickness as the measurement in Step 3
plus or minus .... .002 in. (0.05 mm)
5. Install two rear bolts (1) and (2). Tighten the bolts to
a torque of .... 960 ± 80 lb.ft. (132.8 ± 11.1 mkg)

NOTE: FOR TORQUE VALUES NOT GIVEN, SEE THE FIRST PAGE OF SPECIFICATIONS FOR GENERAL TIGHTENING TORQUES

EQUALIZER BAR

(1) Minimum clearance between the bearing caps and the support must be .... .015 in. (0.38 mm)

To get the clearance do the following:

a. Install .015 in. (0.38 mm) shims between bearing caps (3) and support on the left side of pin.

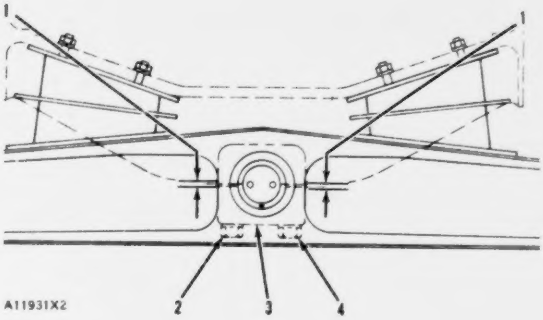
b. Tighten bolts (2) to a torque of .... 400 ± 50 lb.ft. (62.2 ± 6.9 mkg)

c. Tighten bolts (4) to a torque of .... 1000 ± 120 lb.ft. (138.3 ± 16.6 mkg)

d. Remove the shims.

e. Tighten bolts (2) to a torque of .... 1000 ± 120 lb.ft. (138.3 ± 16.6 mkg)

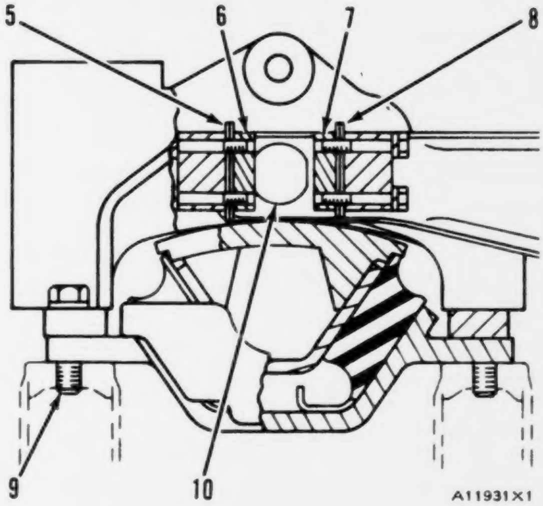
(9) Torque for bolts .... 550 ± 75 lb.ft. (76.1 ± 10.4 mkg)



ADJUSTMENT OF THE EQUALIZER BAR

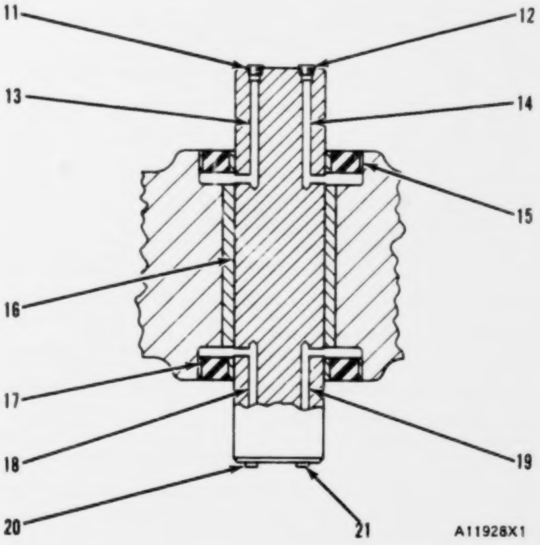
1. Make sure the tracks on each side of the machine are level with each other.
2. Install shims (5), as necessary, until the inside face of wear plates (6) are in contact with pin (10). Make the adjustment on each support assembly (left and right sides of the machine).
3. Add or remove shims (8), as necessary, to get a dimension between wear plates (7) and pin (10) on each support assembly (left and right sides of the machine) of ..... .19 ± .03 in. (4.8 ± 0.8 mm)

NOTE: The maximum clearance between pin (10) and wear plates (7) before shims are added, is .... .375 in. (9.52 mm)

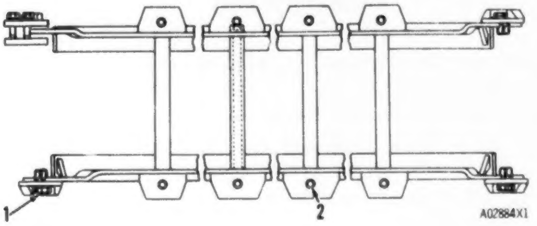


LUBRICATION OF THE EQUALIZER BAR

1. Put the equalizer bar in position so pin (16) is in the vertical position.
2. Remove plugs (11) and (12).
3. Fill the cavity between seal (15) and the bar, through hole (13), with SAE 90 oil until the oil comes out hole (14). The amount of oil will be approximately .14 pint (0.07 l).
4. Install plugs (11) and (12).
5. Turn the equalizer bar so the opposite end of pin (16) is toward the top.
6. Remove plugs (20) and (21).
7. Fill the cavity between seal (17) and the bar, through hole (18), with SAE 90 oil until the oil comes out hole (19). The amount of oil will be approximately .14 pint (0.07 l).
8. Install plugs (20) and (21).



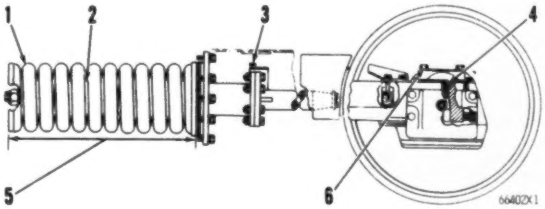
TRACK ROLLER GUARDS



(1) Torque for bolts that hold retainer and guard to frame .... 500 ± 50 lb.ft. (69.2 ± 6.9 mkg)

(2) Torque for bolts that hold guard to frame .... 800 ± 100 lb.ft. (110.6 ± 13.8 mkg)

FRONT IDLERS AND RECOIL SPRINGS



(1) 2P9666 Spring (outer):

Assembled length .... 31.38 in. (797.1 mm)

Test force .... 24.1 ± 1.7 ton (21.9 ± 1.6 t)

Free length after test (new) .... 42.67 ± .75 in. (1083.8 ± 19.1 mm)

Outside diameter .... 11.50 + .25 or - .06 in. (292.1 + 6.4 or - 1.5 mm)

(2) 2P9665 Spring (inner):

Assembled length .... 22.48 in. (571.0 mm)

Test force .... 7.1 ± .5 ton (6.5 ± 0.4 t)

Free length after test (new) .... 30.66 ± .50 in. (778.8 ± 12.7 mm)

Outside diameter .... 6.50 ± .25 in. (165.1 ± 6.4 mm)

(3) Torque for the fill valve and the relief valve .... 25 ± 5 lb.ft. (3.5 ± 0.7 mkg)

(4) Torque for the nuts of the taper lock pins .... 65 lb.ft. (9.0 mkg)

Then hit with hammer and tighten again to .... 75 ± 10 lb.ft. (10.4 ± 1.4 mkg)

(5) Length for assembly, from rear face of rear pilot to front face of front pilot .... 33.00 in. (838.2 mm)

(6) Torque for the bolts .... 350 ± 50 lb.ft. (48.4 ± 6.9 mkg)

(7) Diameter of the shaft .... 3.249 ± .001 in. (82.52 ± 0.03 mm)

Maximum permissible bend in the shaft .... .005 in. (0.13 mm)

(8) End play of the shaft ...... .009 to .031 in. (0.23 to 0.79 mm)

Maximum permissible end play (worn) ..... .050 in. (1.27 mm)

(9) Use shims to make the idler shaft parallel to the roller shafts and to keep the clearance between the plate assembly and the yoke to .... .045 ± .015 in. (1.14 ± 0.38 mm)

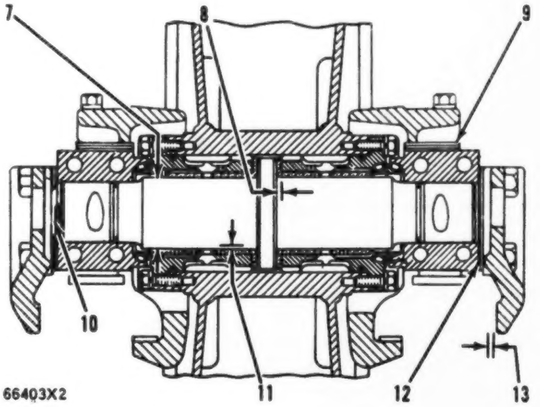
(10) Torque for the plug .... 125 ± 15 lb.ft. (17.3 ± 2.1 mkg)

(11) Clearance between the bearing and the shaft .... .014 to .018 in. (0.36 to 0.46 mm)

Maximum permissible clearance (worn) .... .045 in. (1.14 mm)

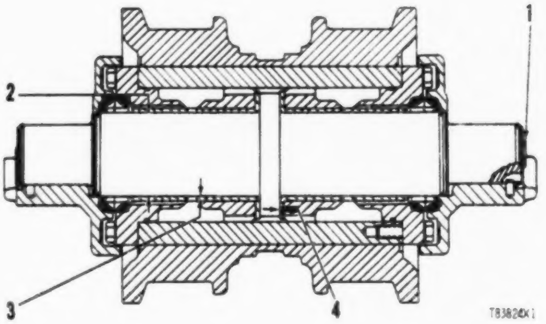
(12) Use shims to get a clearance (13), between frame and guide (each side) of .... .032 ± .016 in. (0.81 ± 0.41 mm)

NOTE: Rubber toric seals and all surfaces that make contact with the seals must be clean and dry. After installation of the seals, put oil on the contact surfaces of the metal seals.



NOTE: FOR TORQUE VALUES NOT GIVEN, SEE THE FIRST PAGE OF SPECIFICATIONS FOR GENERAL TIGHTENING TORQUES

TRACK ROLLERS



(1) Torque for plug .... 125 ± 15 lb.ft. (17.3 ± 2.0 mkg)

Maximum permissible end clearance .... .050 in. (1.27 mm)

(2) Diameter of shaft .... 3.249 ± .001 in. (82.52 ± 0.03 mm)

Maximum permissible amount shaft can be bent .... .005 in. (0.13 mm)

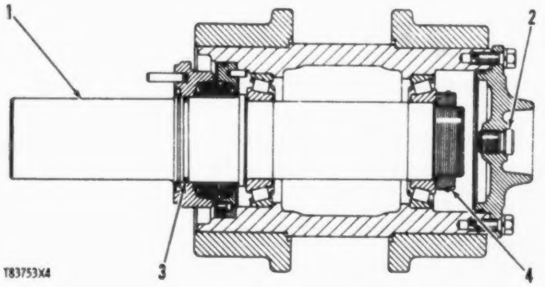
(3) Clearance between shaft and bearing .... .014 to .018 in. (0.36 to 0.46 mm)

Maximum permissible clearance .... .050 in. (1.27 mm)

(4) End clearance of shaft .... .010 to .029 in. (0.25 to 0.74 mm)

NOTE: Rubber toric seals and all surfaces in contact with them must be clean and dry at assembly. Put a thin layer of oil on the surfaces of the metal seals that are in contact just before installation. Put lubricant on all other seals at assembly.

TRACK CARRIER ROLLERS



(1) Assemble shaft even with the back of the bracket. Make an adjustment, if necessary, for track alignment.

(2) Torque for plug .... 125 ± 15 lb.ft. (17.3 ± 2.1 mkg)

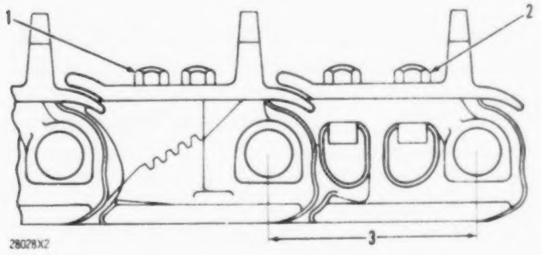
(3) Put lubricant on the inside of collar at assembly.

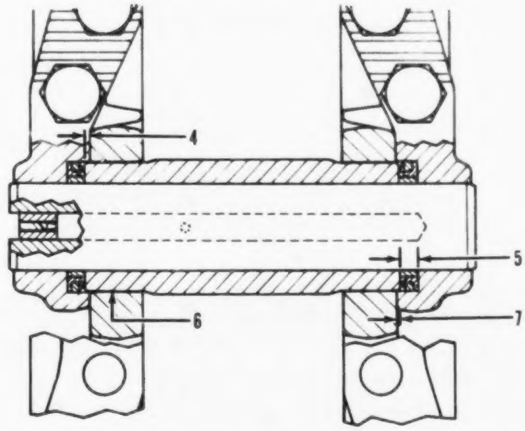
(4) Make an adjustment of the bearings as follows:

1. Hold the shaft and turn the roller.
2. While the roller is being turned, tighten the nut until a resistance on the roller is felt.
3. Turn the nut in the opposite direction to the first position where the lock can be installed.

NOTE: Rubber toric seals and all surfaces in contact with them must be clean and dry at assembly. Put a thin layer of oil on the surfaces of the metal seals that are in contact just before installation. Put lubricant on all other seals at assembly.

TRACK





(1) Torque for bolts that hold the half links together .... 250 ± 50 lb.ft. (34.6 ± 6.9 mkg)

Then turn an additional .... 180°

(2) Torque for bolts that hold track shoes to links .... 250 ± 50 lb.ft. (34.6 ± 6.9 mkg)

Then turn an additional .... 120°

(3) Distance from the center of one pin to the center of the next pin (pitch) .... 9.000 ± .005 in. (228.6 ± 0.13 mm)

(4) Distance from face of link to end of bushing .... .045 ± .005 in. (1.14 ± 0.13 mm)

(5) Thickness of thrust ring (new) .... .437 ± .002 in. (11.10 ± 0.05 mm)

(6) Permissible external wear on bushings before the bushings are turned:

Operations under little or no shock load .... .300 in. (7.62 mm)

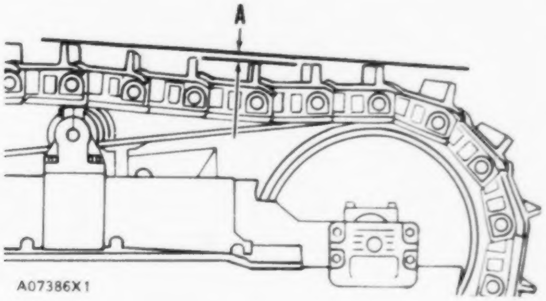
Operations under average or heavy shock load .... .200 in. (5.08 mm)

(7) Maximum permissible end clearance (end play) in joint .... .001 in. (0.03 mm)

Track press assembly force .... 186,000 lb. (84,444.0 kg)

NOTE: FOR TORQUE VALUES NOT GIVEN, SEE THE FIRST PAGE OF SPECIFICATIONS FOR GENERAL TIGHTENING TORQUES

ADJUSTMENT OF THE TRACK



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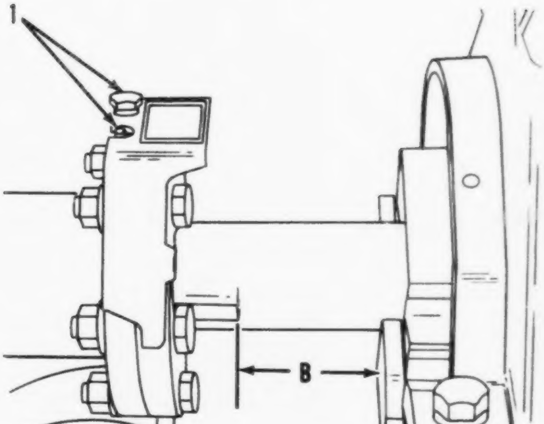

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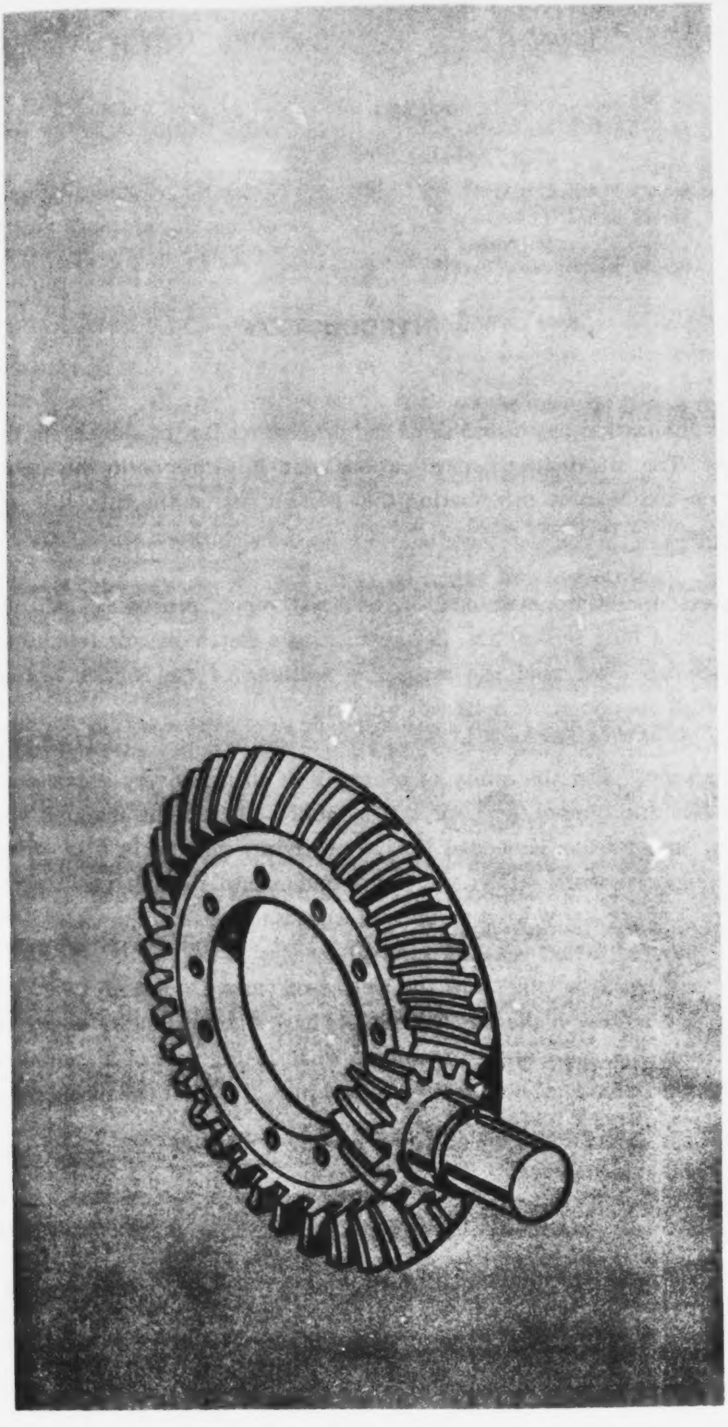
The adjustment of the track is correct when the measurement of the curve in the track (sag) at point (A) halfway between the front carrier roller and the front idler is . . . . 1.5 to 2.0 in. (38.1 to 50.8 mm)

⚠ WARNING: Never visually inspect the vent holes or valves to see if grease or oil is coming out of them. Make sure the vent holes are clean before the tension is released on the track. Watch the cylinder to see that it moves.

CAUTION: Do not tighten the track if clearance (B) between the stop on the recoil rod and the rear face of the support for the equalizer bar is less than . . . . 1.00 in. (25.4 mm)

(1) Torque for fill and relief valves . . . . 25 ± 5 lb.ft. (3.5 ± 0.7 mkg)



SYSTEMS OPERATION
TESTING AND ADJUSTING

D8 POWER TRAIN

SERIAL NUMBERS
66V1-UP
76V1-UP
77V1-UP

INTRODUCTION

This publication has instructions and procedures for the subject on the front cover. The information, specifications, and illustrations in this publication are on the basis of information that was current at the time this issue was written.

Correct operation, maintenance, test and repair procedures will give this product a long service life. Before starting a test, repair or rebuild job, the serviceman must read the respective sections of the Service Manual, and know all the components he will work on.

Your safety, and the safety of others, is at all times very important. When you see this symbol ⊕ or this symbol ⚠ in the manual, you must know that caution is needed for the procedure next to it. The symbols are warnings. To work safely, you must understand the job you do. Read all instructions to know what is safe and what is not safe.

It is very important to know the weight of parts. Do not lift heavy parts by hand. Use a hoist. Make sure heavy parts have a good stability on the ground. A sudden fall can cause an accident. When lifting part of a machine, make sure the machine has blocks at front and rear. Never let the machine hang on a hoist, put blocks or stands under the weight.

When using a hoist, follow the recommendation in the manual. Use correct lift tools as shown in illustrations to get the correct balance of the component you lift. This makes your work safer at all times.

40400X3

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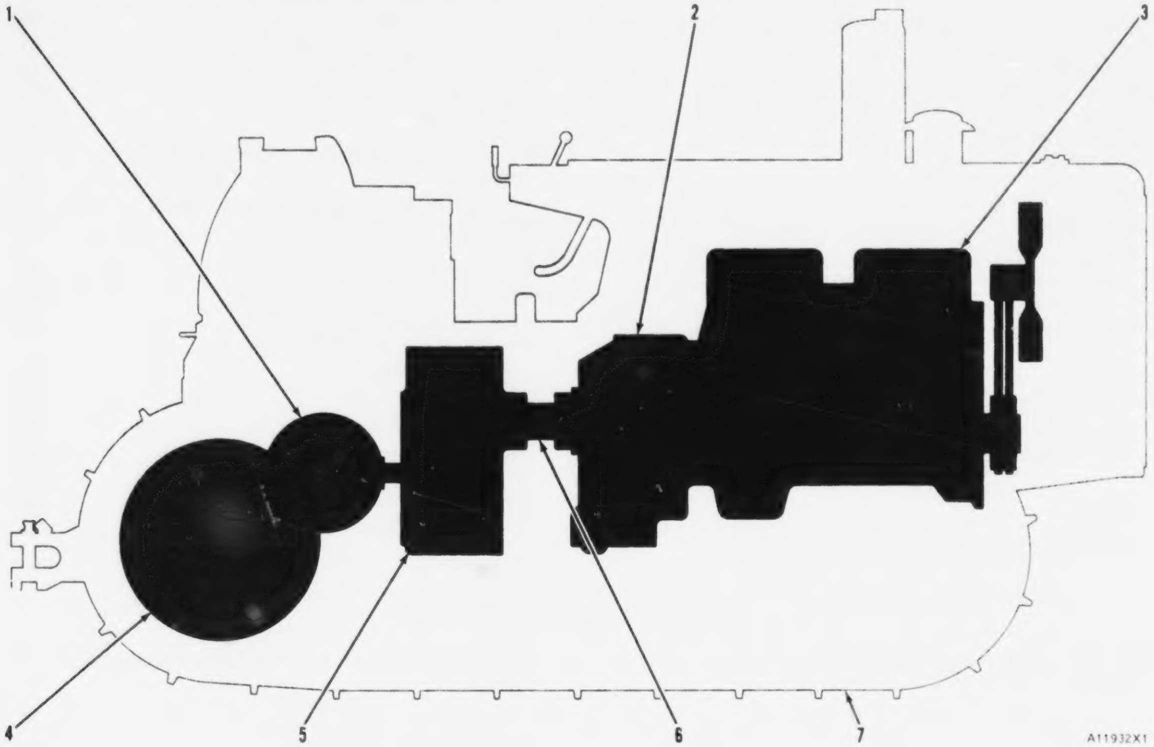
* See SPECIFICATIONS, Form No. SENR7007

SPECIFICATIONS

NOTE: For Specifications with illustrations, make reference to the POWER TRAIN SPECIFICATIONS for D8 TRACTOR, Form No. SENR7007. If the Specifications in Form SENR7007 are not the same as in the Systems Operation and the Testing and Adjusting, look at the printing date on the back cover of each book. Use the Specifications in the book with the latest date.

GENERAL INFORMATION

(POWER SHIFT)



POWER TRAIN

1. Bevel gear. 2. Torque divider. 3. Diesel engine. 4. Final drives. 5. Transmission. 6. Universal joint. 7. Tracks.

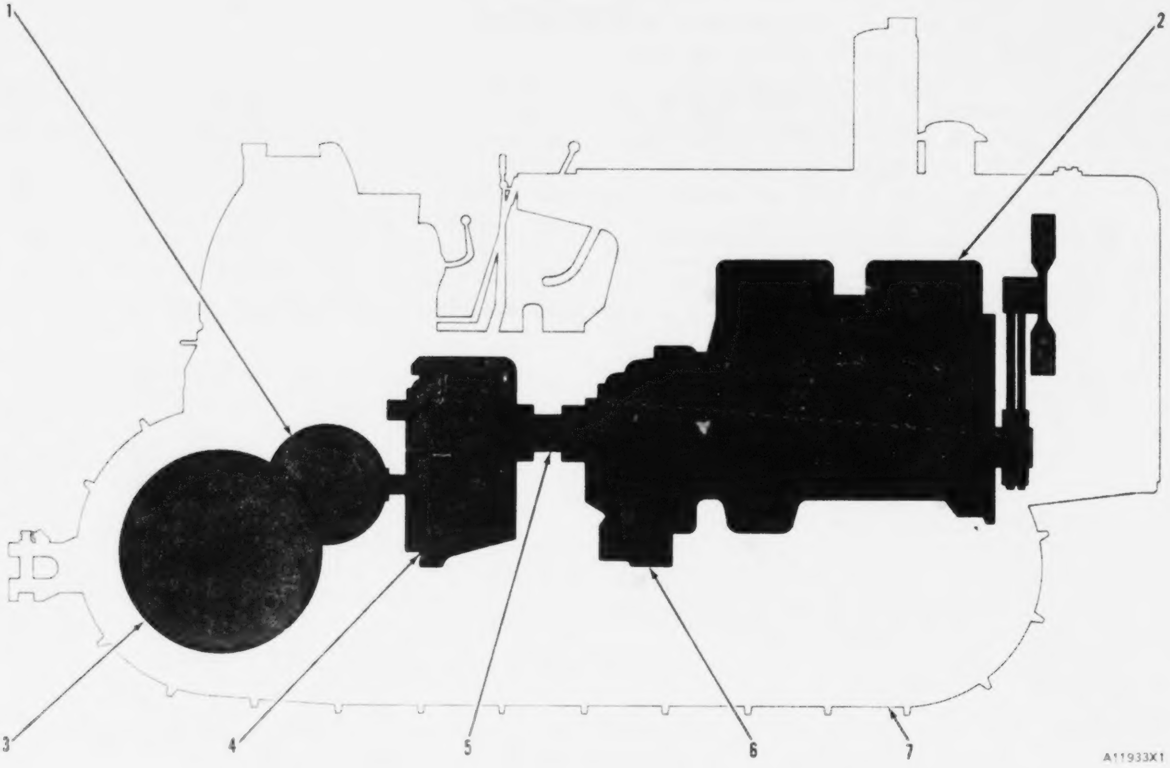
The power from the diesel engine is sent through the torque divider, universal joint, transmission, bevel gear, steering clutches and final drives to the tracks.

The torque divider sends the power to the universal joint through a planetary gear system and torque converter.

The transmission has three speeds FORWARD and three speeds REVERSE. Valve spools, in the transmission hydraulic controls, control the clutches in the transmission for the speed and direction of the tractor. The valve spools are connected to the transmission control lever.

The steering clutches are used to turn the tractor. The brakes are used to stop the tractor and give assistance to the action of the steering clutches.

(DIRECT DRIVE)



POWER TRAIN

1. Bevel gear. 2. Diesel engine. 3. Final drive. 4. Direct drive transmission. 5. Universal joint. 6. Flywheel clutch. 7. Track.

The power from the diesel engine is sent through the flywheel clutch, universal joint, transmission, bevel gear, steering clutches, and final drives to the tracks.

When the flywheel clutch is engaged, the power from the engine goes to the transmission. The transmission has six speeds FORWARD and six speeds REVERSE. The selection of the speed of the transmission is done by the speed selection lever. The selection of the direction of the transmission is done by the FORWARD-REVERSE lever.

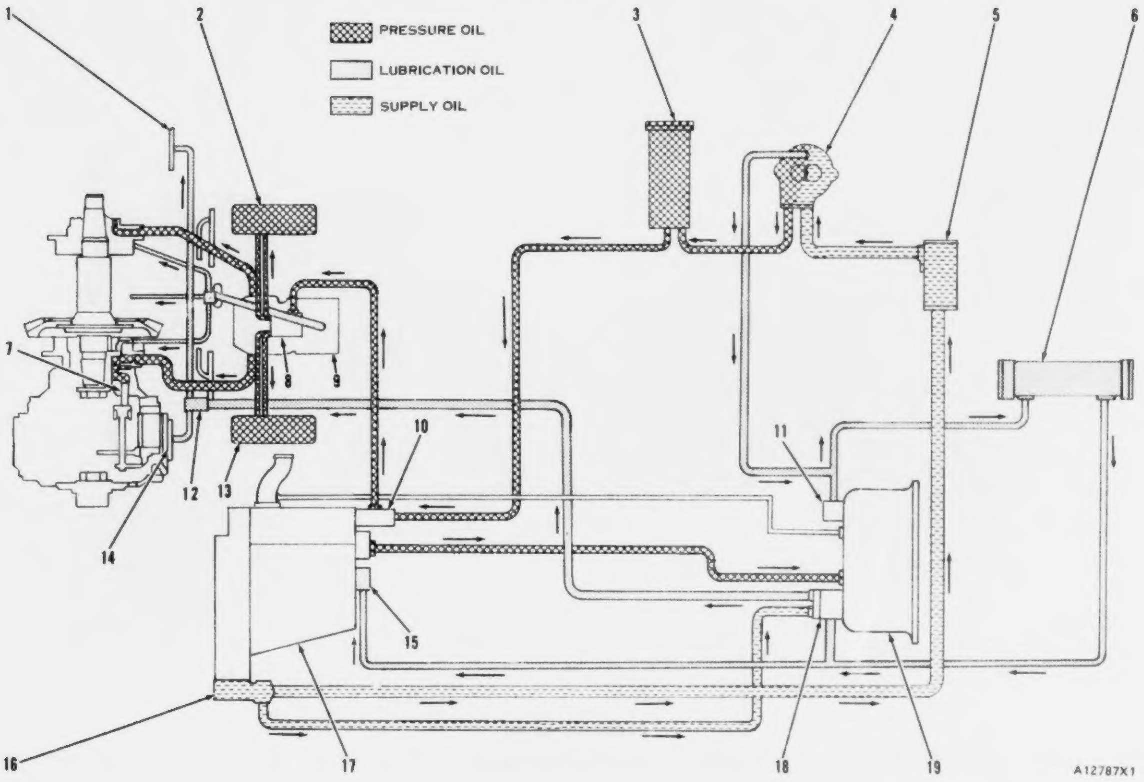
When the levers move into a speed and a direction position, the gears in the transmission move into a speed and direction position.

The interlock mechanism is controlled by the control lever for the flywheel clutch. It prevents the movement of the gears in the transmission when the flywheel clutch is engaged. It also keeps the transmission in one speed at a time.

The steering clutches are used to turn the tractor. The brakes are used to stop the tractor and give assistance to the action of the steering clutches.

HYDRAULIC SYSTEM

(POWER SHIFT)



SCHEMATIC OF THE HYDRAULIC SYSTEM

1. Left brake band. 2. Hydraulic control mechanism for the left brake. 3. Oil filter. 4. Transmission oil pump. 5. Magnetic screen. 6. Oil cooler. 7. Steering clutch piston. 8. Oil manifold. 9. Hydraulic control valve for the steering clutches and brakes. 10. Priority valve. 11. Outlet relief valve for torque converter. 12. Relief valve for brake cooling and lubrication. 13. Hydraulic control mechanism for the right brake. 14. Right brake band. 15. Lubrication oil manifold. 16. Reservoir in steering clutch and bevel gear case. 17. Transmission case. 18. Oil pump. 19. Torque divider case.

The hydraulic system has a common reservoir. It gives lubrication oil for the bevel gear and pinion, transmission and torque divider. It also gives cooling oil for the torque converter, steering clutches and brakes. Pressure oil from the oil pump is for operation of the hydraulic controls for the steering clutches and brakes, the hydraulic controls of the transmission and the torque converter. For more explanation of hydraulic controls, see the subjects "TRANSMISSION HYDRAULIC CONTROLS" and "STEERING CLUTCHES AND BRAKES" in this manual.

Oil is pulled from reservoir (16) through the magnetic screen (5) by oil pump (4). An oil line goes from pump (4) and makes a connection with a line from the outlet relief valve (11) for the torque converter. When the engine is first started, this line lets any air in the suction section of the pump go out of the pump. The operation of the pump starts faster. After the engine is running, this oil line lets a specific amount of oil go to the outlet relief valve (11).

The pump (4) sends pressure oil to oil filter (5). The oil goes through the filter to priority valve (10) and oil manifold (8). If the oil filter element has restrictions, a bypass valve in the filter housing lets the oil go directly to priority valve (10) and oil manifold (8).

The oil to manifold (8) goes through the manifold to hydraulic control valve (9) for the steering clutches and brakes. This oil is used for the operation of the steering clutches and hydraulic control mechanisms (2) and (13) for the brakes. A small amount of oil goes from control valve (9) through an orifice. This oil is for the lubrication of the control valve, bevel gear and bearings for the bevel gear shaft.

The priority valve lets oil go to the hydraulic controls for the steering clutches and brakes before oil goes to the transmission hydraulic controls. An orifice in the priority valve body lets a small amount of oil go to the transmission hydraulic controls at all times. This keeps the priority valve from completely stopping the flow of oil to the transmission hydraulic controls if a steering clutch or brake is activated when the output of pump (4) is low.

From the priority valve, the oil goes to the transmission hydraulic controls. This oil is for the operation of transmission hydraulic controls. At the same time, oil goes to the inlet relief valve for the torque converter. The inlet relief valve for the torque converter controls the inlet pressure to the torque converter. Leakage of oil inside the torque converter is for lubrication of the torque divider components. After lubrication of the components, this oil goes to the bottom of the torque divider housing.

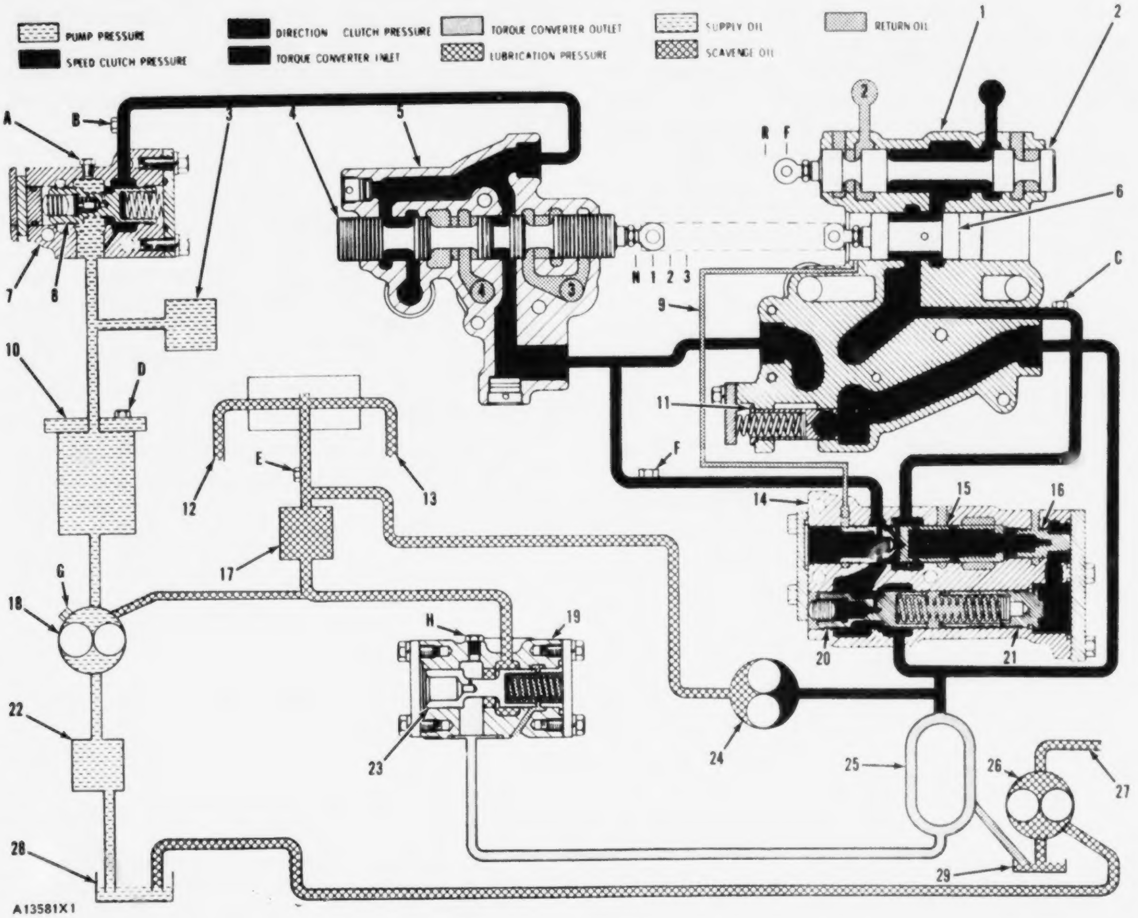
The scavenge section of oil pump (18) takes oil from the bottom of the torque divider housing. The pump also takes oil from the reservoir in the bevel gear case. The oil goes from the pump to relief valve (12). From relief valve (12), the oil goes to brake bands (1) and (14) for cooling and lubrication.

Outlet oil from the torque converter goes to outlet relief valve (11). Outlet relief valve (11) controls the pressure inside the torque converter. From the outlet relief valve the oil goes to oil cooler (6) on the engine. After the oil is made cool, part of the oil goes to the transmission for lubrication. The remainder of the oil goes to the inlet side of the circulating section of pump (18). This oil adds with the oil from the inlet relief valve for the torque converter.

Oil not used by the transmission hydraulic controls is sent to the inlet relief valve for the torque converter. Oil, not used by the torque converter goes to the reservoir in the bevel gear case.

TRANSMISSION HYDRAULIC CONTROLS

(POWER SHIFT)


PUMP PRESSURE
SPEED CLUTCH PRESSURE
DIRECTION CLUTCH PRESSURE
TORQUE CONVERTER INLET
TORQUE CONVERTER OUTLET
LUBRICATION PRESSURE
SUPPLY OIL
SCAVENGE OIL
RETURN OIL
A
B
3
4
5
1
2
R F
6
N 1 2 3
C
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HYDRAULIC CONTROLS (FIRST SPEED FORWARD)

1. Safety and direction valve housing.
2. Direction selection valve.
3. Hydraulic controls for steering clutches and brakes.
4. Speed selection valve.
5. Housing for speed selection valve.
6. Safety selection valve.
7. Priority valve housing.
8. Priority valve.
9. Line to safety selection valve.
10. Oil filter.
11. Relief valve for converter inlet.
12. Lubrication line to rear of transmission.
13. Lubrication line to front of transmission.
14. Pressure control valve body.
15. Pressure differential and safety valve.
16. Check valve.
17. Oil cooler.
18. Transmission oil pump.
19. Housing for relief valve for converter outlet.
20. Modulation relief valve.
21. Load piston.
22. Magnetic strainer.
23. Relief valve for converter outlet.
24. Recirculating oil pump.
25. Torque converter.
26. Scavenge oil pump.
27. Lubrication line for brake cooling.
28. Reservoir in bevel gear case.
29. Reservoir in torque divider housing.

A. Pressure tap for transmission oil pump.
B. Pressure tap for speed clutch.
C. Pressure tap for direction clutch.
D. Pressure tap for transmission oil pump.
E. Pressure tap for lubrication.
F. Pressure tap for speed clutch.
G. Pressure tap for transmission oil pump.
H. Pressure tap for the outlet from the torque converter.

The transmission hydraulic controls are made up of a pump, filter, control valves, a selection lever and a linkage mechanism. The hydraulic controls send oil to the clutches in the transmission. Oil, not used by the clutches in the transmission, is sent by modulation relief valve (20) to relief valve (11) for torque converter inlet.

The location of transmission oil pump (18) is on the right side of the power take-off housing on the engine. The pump pulls the oil from reservoir (28) and sends it to filter (10) on the right side of the engine. From the filter, the oil goes to the transmission hydraulic controls in the top compartment of the transmission and to hydraulic control (3) for the steering clutches and brakes.

The oil for the transmission hydraulic controls is first sent to priority valve (8). The priority valve makes sure that approximately 415 psi (29.2 kg/cm^2) of pressure oil is available to hydraulic controls (3) for the steering clutches at all times. The pressure of the oil opens the priority valve. The priority valve then lets the remainder of the oil from the pump go to speed selection valve (4). The maximum pressure of the oil to the speed selection valve is controlled to approximately 345 psi (24.3 kg/cm^2) by the priority valve when the clutches are filled.

Speed selection valve (4) is a four position valve which is moved by mechanical linkage. The valve lets some of the oil go to one of the three speed clutches (No. 3, No. 4 or No. 5). A parallel passage in the speed selection valve lets the remainder of the oil go to pressure control valve (14).

The pressure control valve (14) has two valves: modulation relief valve (20) and pressure differential and safety valve (15). These valves work in combination to control the maximum pressure in the system, the rate of pressure increase in the system and the correct sequence of clutch engagement.

Modulation relief valve (20) controls maximum pressure in the system and prevents sudden clutch engagement. It sends the extra oil to relief valve (11) for torque converter inlet. Relief valve (11) for torque converter inlet is in direction valve housing (1). It controls the maximum pressure to torque converter (25).

Pressure differential and safety valve (15) lets a speed clutch become engaged before any oil is sent to a direction clutch. This arrangement permits smooth engagement and lets the direction clutch (No. 1 or No. 2) take most of the load. Pressure differential and safety valve (15) changes the pressure to the direction clutch to approximately 55 psi (3.9 kg/cm^2) less than the speed clutch pressure.

The position of safety valve (6) prevents pressure differential and safety valve (15) from opening if the engine is started with the selection lever in any position except NEUTRAL. Safety valve (6) stops the flow of oil to direction valve (2) when the selection lever is in the NEUTRAL position. The safety valve is connected to speed selection valve (4) by mechanical linkage.

Direction selection valve (2) is in the same housing as safety valve (6). The position of the direction selection valve is controlled by mechanical linkage. The mechanical linkage is connected to the transmission selection lever. The position of the direction selection valve (2) lets oil go to one of the direction clutches (No. 1 or No. 2).

The location of the transmission selection lever is at the left side of the operator's seat. The mechanical linkage connects the selection lever to the speed selection valve and the direction selection valve. Speed shifts are made by the movements of the selection lever to the front or rear. Direction shifts are made by the movement of the selection lever to the right or left.

OPERATION

When the engine is started, oil pump (18) pulls oil from reservoir (28) through magnetic strainer (22). The pump sends the oil through filter (10) to priority valve (8) and hydraulic control (3) for the steering clutches and brakes.

When hydraulic controls (3) for the steering clutches are filled, the pressure of the oil to priority valve (8) increases. As the pressure increases, the plunger in the priority valve will open. When the oil fills the slug chamber at the left of the valve, the pressure of the oil will increase to approximately 415 psi (29.2 kg/cm^2). The pressure of the oil can now move the priority valve to the right. The movement of the priority valve opens a passage for the flow of oil to speed selection valve (4).

When the selection lever is in the NEUTRAL position, speed selection valve (4) and safety valve (6) are moved to the left. In this position, the speed selection valve lets oil go through passages to the No. 3 clutch. Oil also goes to pressure control valve (14). Since the engine was just started, the pressure in the system is low. The spring holds differential and safety valve (15) all the way to the left. Modulation relief valve (20) is held all the way to the left by the force of its spring. Oil can not go to safety and direction valve housing (1).

When the area behind the piston in the No. 3 clutch is filled with oil, the pressure of the oil will increase. The increase in pressure will move modulation valve (20) to the right against the force of its spring. This opens a passage which lets some of the oil go to relief valve (11) for torque converter inlet. In the NEUTRAL position, a land of safety valve (6) is over line (9) to the top of differential and safety valve (15). With this line closed to the reservoir, the pressure of the oil will open the poppet valve in valve (15). When the oil fills the chamber at the left of the valve, the pressure of the oil increases. The increase in the pressure of the oil moves differential and safety valve (15) to the right. The movement of the differential and safety valve opens a passage for the flow of oil to safety and direction valve housing (1). It also closes the passage to the reservoir. In the NEUTRAL position, the flow of oil to direction selection valve (2) is stopped by the position of safety valve (6). With the flow of oil stopped by the safety valve, the pressure of the oil to housing (1) increases to approximately 55 psi (3.9 kg/cm²) less than the pressure to the left end of differential and safety valve (15).

This pressure oil is also felt by check valve (16). An orifice in the check valve slows the flow of pressure oil. The pressure oil will move the check valve to the right to close the passage to reservoir. The oil then goes through the orifice and fills the space behind load piston (21). As the pressure of the oil becomes higher, load piston (21) will move to the left. The pressure of the oil behind the load piston and the force of the spring will move modulation relief valve (20) to the left. When the relief valve moves to the left, it stops the flow of oil to relief valve (11). This causes the pressure of the oil (speed clutch pressure), to the left of the modulation relief valve, to make an increase.

As the speed clutch pressure becomes higher, relief valve (20) moves to the right again to open the passage to relief valve (11) for converter inlet. The pressure to the safety and direction valve housing (1) also becomes higher. This increase in pressure goes through the orifice in the check valve (16) and is felt by load piston (21). The higher pressure, plus the spring force, moves relief valve (20) to the left again. This cycle takes place again and again until the load piston moves completely to the left against its stop. Speed clutch pressure is then at a maximum of approximately 345 psi (24.3 kg/cm²). The pressure stopped by safety valve (6) and felt at the right of load piston (21) is approximately 55 psi (3.9 kg/cm²) less than the speed clutch pressure. This gradual increase in pressure is called modulation. Relief valve (20) gives modulation for all the clutches (speed and direction). Any higher pressure will open the relief valve to let the extra pressure go to relief valve (11) for converter inlet.

Since the safety valve stops the flow of oil to direction selection valve (2), a direction clutch can not engage. One speed clutch and one direction clutch must be engaged before the output shaft of the transmission will turn.

When the selection lever is moved from the NEUTRAL position to the FIRST FORWARD position, speed selection valve (4) and safety valve (6) are moved to the right.

In this position, the speed selection valve sends oil to the No. 5 clutch. The oil in the No. 3 clutch is released to the reservoir. Oil can still go to pressure control valve (14).

As the No. 5 clutch fills, the pressure of the oil decreases. This lets modulation relief valve (20) and differential and safety valve (15) move to the left and load piston (21) move to the right.

When relief valve (20) moves to the left, it stops the flow of oil to relief valve (11) for converter inlet. When differential and safety valve (15) moves to the left, it stops the flow of oil to safety and direction valve housing (1). It also opens a passage to the reservoir from housing (1). With the passage behind the differential and safety valve (15) open to the reservoir, check valve (16) can also move to the left. This opens a passage to the reservoir for the oil behind load piston (21). The plunger in the safety and differenital valve slows the release of pressure oil to the left of the valve. This prevents the valve from moving completely to the left to open the passage to the reservoir by safety valve (6).

When the No. 5 clutch is filled, the pressure of the oil will increase. The increase in pressure will open modulation relief valve (20) and differential and safety valve (15) again. In the FIRST FORWARD position, safety valve (6) and direction selection valve (2) are in a position to let oil from the differential valve go to the No. 1 clutch.

When the No. 1 clutch is filled, the pressure of the oil to housing (1) and behind load piston (21) will increase. Relief valve (20) and load piston (21) once again work in combination to give modulation to the increase in pressure to the speed and direction clutches. When the load piston has moved completely to the left against its stop, the pressure of the oil to the No. 5 clutch (speed) is at the maximum setting. The pressure of the oil to the No. 1 clutch (direction) is approximately 55 psi (3.9 kg/cm²) lower because of the action of the differential valve.

The hydraulic controls work in the same way when a selection of another speed is made.

SAFETY VALVE

Safety valve (6) prevents movement of the machine if the engine is started with the transmission in a speed position or if the pressure in the hydraulic controls decreases below normal pressure of operation.

When the machine is in operation with the selection lever in a speed position, pressure oil in the chamber between valve (15) and the cover of valve body (14) keeps valve (15) away from the cover. The position of valve (15) lets oil go to safety valve (6). The position of safety valve (6) lets oil go to a direction clutch. The clutches for that speed are engaged and the operation of the transmission hydraulic controls is normal.

When the pressure of the oil in the chamber between valve (15) and the cover of valve body (14) is low (engine stopped), valve (15) is all the way against the cover of valve body (14). Valve (15) will not move until the pressure in the chamber increases.

When the engine is started with the transmission in a speed position, the oil from the priority valve goes to speed selection valve (4). The oil starts to fill a speed clutch. At the same time, oil goes to pressure differential and safety valve (15). Since the pressure in the chamber is low, valve (15) is all the way against the cover. The oil opens a poppet in valve (15). This oil goes into the chamber between valve (15) and the cover of valve body (14). Since valve (15) is against the cover, line (9) is open from the chamber to the left end of safety valve (6). When the speed selection valve (4) and safety valve (6) are in a speed position, line (9) at the left end of the safety valve (6) is open to reservoir. The pressure of the oil in the chamber between valve (15) and the cover of valve body (14) does not increase. Valve (15) does not move and stops the oil to the safety valve (6). No oil can go to a direction clutch. Since both a speed and direction clutch must be engaged in the transmission, the machine will not move.

The poppet valve in valve (15) prevents valve (15) from moving all the way against the cover when the transmission makes a shift.

The selection lever must be moved to NEUTRAL before oil can go to the direction clutch circuit. When the selection lever is in NEUTRAL, the position of safety valve (6) closes line (9) at the left end of the valve to the reservoir. The pressure in the chamber between valve (15) and the cover of valve body (14) can increase. Valve (15) moves and oil can go to the safety valve (6) and the direction clutch circuit.

RELIEF VALVE FOR TORQUE CONVERTER OUTLET

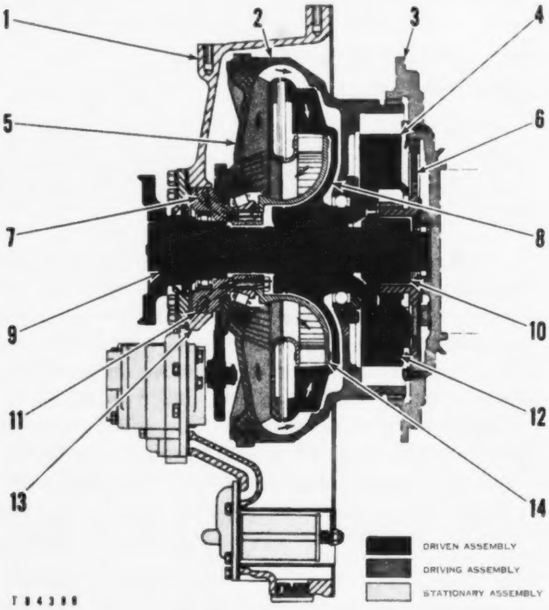
Relief valve (23) for the converter outlet controls the rate that oil is released from the torque converter. This keeps the pressure of the oil in the torque converter constant.

Pressure oil from torque converter (25) goes into housing (19) for relief valve (23). The oil goes through a hole in relief valve (23). The oil fills the chamber at the left of the relief valve. When the chamber is filled, the relief valve moves to the right. The movement of the relief valve opens a passage to oil cooler (17). The relief valve will move to the right to release pressure oil from the torque converter. The relief valve will release oil to the oil cooler until the pressure of the oil in the torque converter is approximately 42 psi (2.9 kg/cm²).

TORQUE DIVIDER
(POWER SHIFT)

The torque divider connects the engine to the planetary transmission. This connection is both a hydraulic connection and a mechanical connection. The hydraulic connection is through a torque converter. The mechanical connection is through a planetary gear set.

The torque converter uses oil from the transmission hydraulic controls to multiply the torque to the transmission. When the machine is working against a low load, the torque multiplication is low. When the machine is working against a high load, the torque multiplication is higher. A higher torque can then be sent to the transmission during high load conditions. The planetary gear set also multiplies the torque from the engine by making an increase in the mechanical advantage through its gears. This torque multiplication also makes an increase as the load on the machine becomes higher. During no load conditions. neither the torque converter nor the planetary gear set can multiply the torque from the engine.



TORQUE DIVIDER

1. Torque divider housing. 2. Housing. 3. Diesel engine flywheel. 4. Ring gear. 5. Impeller. 6. Sun gear. 7. Inlet passage. 8. Turbine. 9. Output shaft. 10. Planet carrier. 11. Outlet passage. 12. Planet gears (three). 13. Carrier. 14. Stator.

The torque divider is installed into flywheel (3). Torque divider housing (1) is installed on the engine flywheel housing. Output shaft (9) is connected to the planetary transmission. A bearing at the rear of housing (1) holds the torque divider in alignment with the flywheel.

The planetary gear set is made up of a sun gear (6), planet carrier (10), planet gears (12) and ring gear (4). Sun gear (6) is connected to flywheel (3) by splines. Planet carrier (10) is connected to output shaft (9) by splines. Planet gears (12) are held by planet carrier (10) and are engaged with the sun gear (6) and ring gear (4).

The torque converter is made up of housing (2), impeller (5), turbine (8) and stator (14). Housing (2) is connected to flywheel (3) by splines. Impeller (5) is connected to housing (2) by bolts. The turbine (8) is connected to ring gear (4) by splines. Stator (14) is connected to carrier (13) by bolts. Carrier (13) is connected to the torque divider housing (1) and can not turn.

Oil for the operation of the torque converter is from the transmission hydraulic controls. A relief valve for converter inlet controls the pressure of the oil to the torque converter. A relief valve for converter outlet controls the pressure of the oil in the converter.

OPERATION

The torque converter is driven by the engine through housing (2). The planetary gear set is driven by the engine through sun gear (6). These connections let the torque output of the engine go in two separate directions. Because of the larger radius of ring gear (4), most of this torque is sent by the torque converter through the ring gear to planet gears (12). The remainder of the torque is sent by sun gear (6) to planet gears (12). If planet carrier (10) has no resistance to rotation (no load), sun gear (6), planet gears (12), planet carrier (10) and ring gear (4) will turn at the same speed. The torque from the converter and from the planetary gear set is now through the planet carrier to output shaft (9) and the planetary transmission. Neither the torque converter nor the planetary gear set can multiply the torque from the engine when they are turning at the same speed.

When the machine has a load, planet carrier (10) has a resistance to rotation. Since sun gear (6) is turning at the rpm of the engine, this resistance to rotation causes planet gears (12) to turn on their shafts. Their rotation is opposite the rotation of ring gear (4). This causes a reduction in the speed of the ring gear. Since turbine (8) is connected to the ring gear, a reduction in speed will cause the torque converter to multiply the torque of the engine from housing (2). The torque multiplication is sent to planet carrier (10) and the output shaft through the ring gear.

With the reduction in the speed of the ring gear, the torque of the engine through sun gear (6) and the planetary gear set also multiplies. This torque multiplication is also sent to planet carrier (10) and the output shaft.

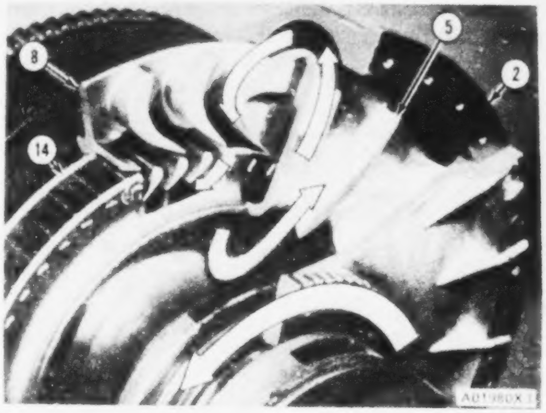
If the resistance to rotation of planet carrier (10) becomes higher (more load on the machine), the ring gear will make more of a reduction in speed. The slower speed will let the torque multiplication through both the torque converter and the sun gear become higher. If the resistance to rotation of the planet carrier becomes high enough, the ring gear will stop. During some very high load conditions, the rotation of the planet carrier and the output shaft will also stop. This will cause the ring gear to turn slowly in the opposite direction. At this time the torque multiplication of the torque converter and the sun gear is at its maximum.

Operation of the Torque Converter

Oil for the operation of the torque converter goes through inlet passage (7) in carrier (13) to impeller (5). The rotation of the impeller gives force to the oil. The impeller sends the oil toward the outside of the impeller, around the inside of housing (2) to turbine (8). The force of the oil hitting the blades of the turbine causes the turbine to turn. Since the turbine is connected to ring gear (4), torque is sent to planet gears (12). At this point in time, the torque given to the turbine by the force of the oil from the impeller can not be more than the torque output of the engine to the impeller.

As the oil goes from the turbine, it is moving in a direction opposite to the direction of impeller (5) rotation. Stator (14) causes the oil to change direction. Since the stator is connected to carrier (13) and can not turn, most of the oil is sent back to impeller (5). The remainder of the oil goes from the stator through outlet passage (11) to the oil cooler and the transmission lubrication system.

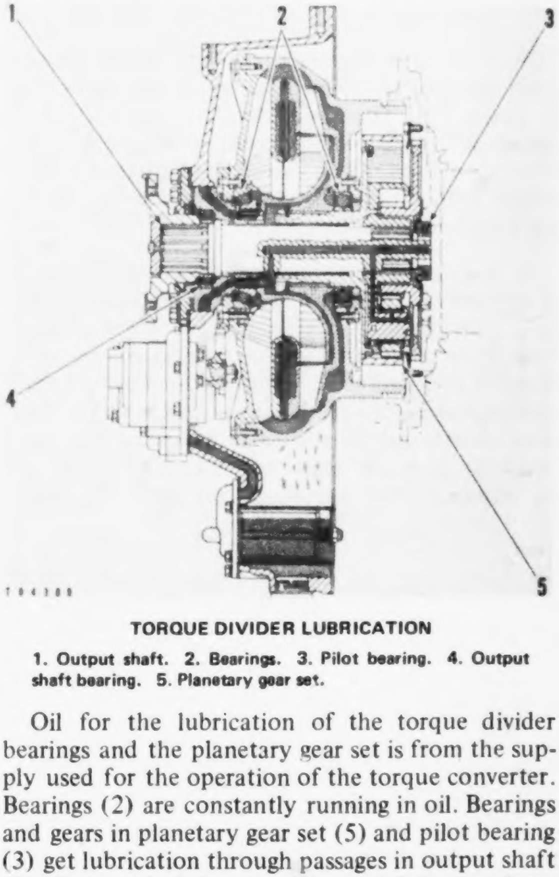
The force of the oil from the stator can now add to the torque output from the engine to the impeller. This extra force can give an increase to the torque output of the engine to the turbine. The larger the difference between the speeds of the impeller and the turbine, the larger the amount of force of the oil from the stator. Since it is the load on the machine that changes the speed of the turbine, the higher the load, the larger the difference in the speeds of the impeller and the turbine. It is then the different loads on the machine that control the amount of torque multiplication that the force of the oil from the stator can add.



FLOW OF OIL THROUGH TORQUE CONVERTER

2. Housing. 5. Impeller. 8. Turbine. 14. Stator.

TORQUE DIVIDER LUBRICATION



TORQUE DIVIDER LUBRICATION

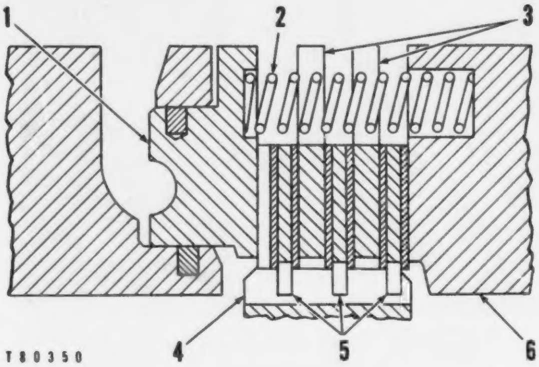
1. Output shaft. 2. Bearings. 3. Pilot bearing. 4. Output shaft bearing. 5. Planetary gear set.

Oil for the lubrication of the torque divider bearings and the planetary gear set is from the supply used for the operation of the torque converter. Bearings (2) are constantly running in oil. Bearings and gears in planetary gear set (5) and pilot bearing (3) get lubrication through passages in output shaft (1). Output shaft bearing (4) gets lubrication from normal oil leakage by a piston ring-type seal.

TRANSMISSION

(POWER SHIFT)

The transmission has three speeds FORWARD and three speeds REVERSE. It has planetary gear systems and five hydraulic clutches.

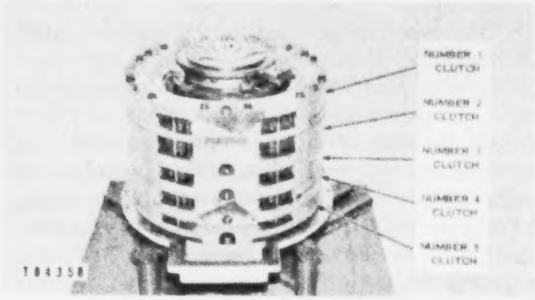


CLUTCH OPERATION

1. Piston. 2. Spring. 3. Plates. 4. Ring gear. 5. Discs. 6. Clutch housing.

The five transmission clutches are the disc type and in separate housings. Each clutch has discs (5) and plates (3). The inside teeth of discs (5) are engaged with the outside teeth of ring gear (4). Notches on the outside diameter of plates (3) are engaged with pins in the clutch housing. The pins keep the plates from turning.

The springs (2) are between clutch housing (6) and piston (1). The springs keep the clutches disengaged (not engaged). The clutches are engaged when oil is sent into the area behind piston (1). When the pressure of the oil in the area behind the piston increases, the piston moves to the right. The piston moves against the force of spring (2) and pushes the discs and plates together. The clutch is now engaged. The disc keep ring gear (4) from turning. When the clutch is released, the pressure in the area behind piston (1) decreases and the springs now push the piston to the left. The discs and plates are now apart. The clutch is not engaged.

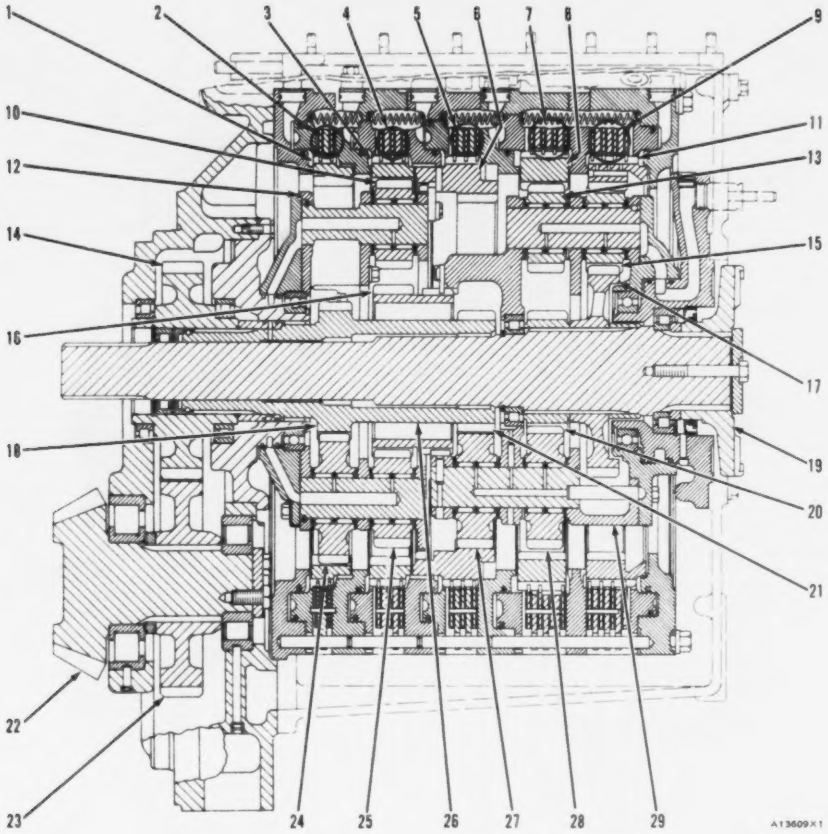


CLUTCH IDENTIFICATION

The two front clutches (No. 1 and No. 2) are direction clutches. The No. 1 clutch is the FORWARD direction clutch. The No. 2 clutch is the REVERSE direction clutch. The three rear clutches (No. 3, No. 4 and No. 5) are speed clutches.

A speed and a direction clutch must be engaged in the transmission before power goes through the transmission.

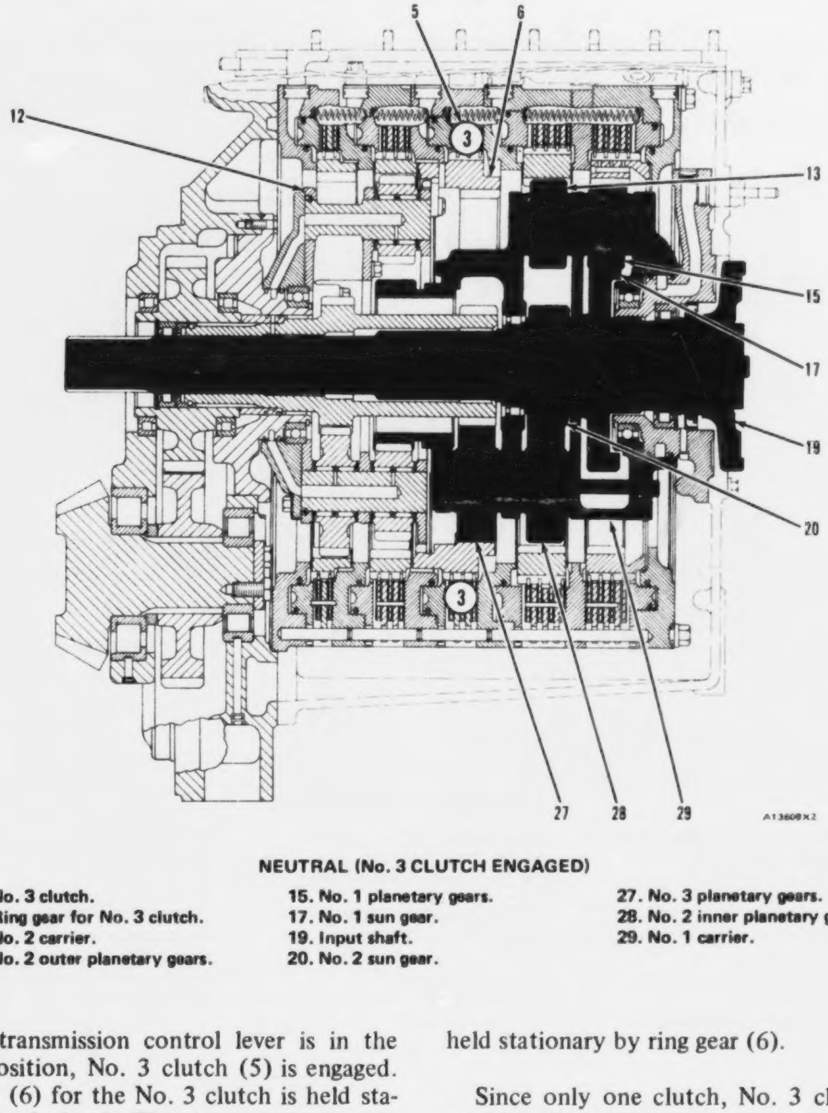
SPEED	CLUTCHES ENGAGED
First Forward	1 and 5
Second Forward	1 and 3
Third Forward	1 and 4
First Reverse	2 and 5
Second Reverse	2 and 3
Third Reverse	2 and 4



TRANSMISSION COMPONENTS

1. Ring gear for No. 5 clutch.
2. No. 5 clutch.
3. Ring gear for No. 4 clutch.
4. No. 4 clutch.
5. No. 3 clutch.
6. Ring gear for No. 3 clutch.
7. No. 2 clutch.
8. Ring gear for No. 2 clutch.
9. No. 1 clutch.
10. No. 4 outer planetary gears.
11. Ring gear for No. 1 clutch.
12. No. 2 carrier.
13. No. 2 outer planetary gears.
14. Transfer gear.
15. No. 1 planetary gears.
16. No. 4 sun gear.
17. No. 1 sun gear.
18. No. 5 sun gear.
19. Input shaft.
20. No. 2 sun gear.
21. No. 3 sun gear.
22. Bevel pinion.
23. Transfer gear.
24. No. 5 planetary gears.
25. No. 4 inner planetary gears.
26. Output shaft.
27. No. 3 planetary gears.
28. No. 2 inner planetary gears.
29. No. 1 carrier.

NEUTRAL



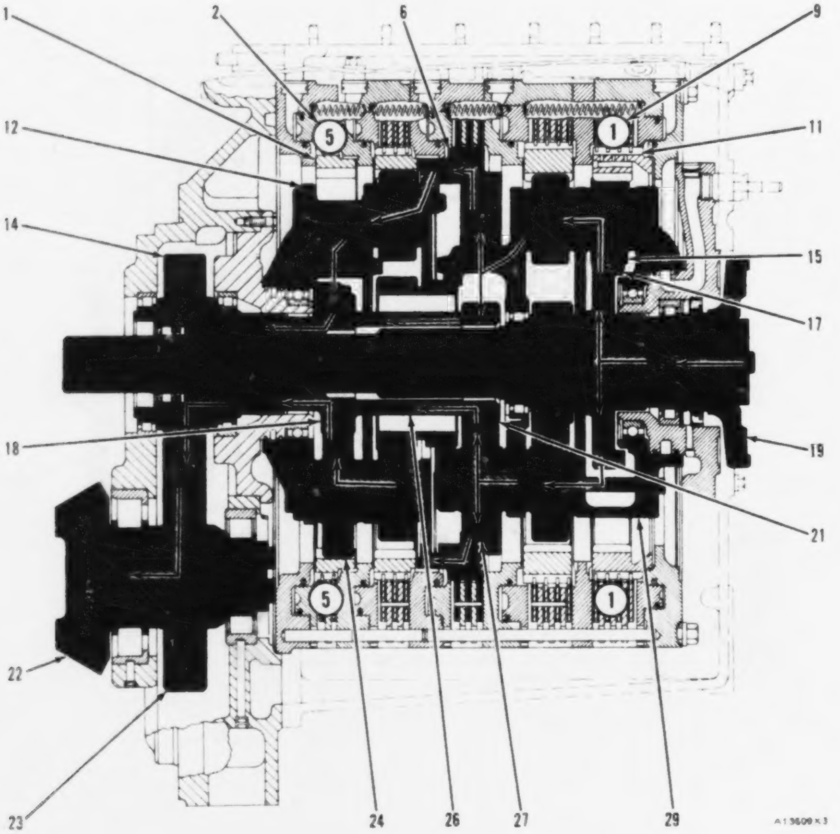
NEUTRAL (No. 3 CLUTCH ENGAGED)

5. No. 3 clutch.
6. Ring gear for No. 3 clutch.
12. No. 2 carrier.
13. No. 2 outer planetary gears.
15. No. 1 planetary gears.
17. No. 1 sun gear.
19. Input shaft.
20. No. 2 sun gear.
27. No. 3 planetary gears.
28. No. 2 inner planetary gears.
29. No. 1 carrier.

When the transmission control lever is in the NEUTRAL position, No. 3 clutch (5) is engaged. The ring gear (6) for the No. 3 clutch is held stationary by No. 3 clutch. The ring gear (6) is connected to No. 2 carrier (12). The No. 2 carrier is held stationary by ring gear (6).

Since only one clutch, No. 3 clutch (5), is engaged in the transmission, power does not go to the bevel gear.

FIRST SPEED FORWARD



POWER FLOW IN FIRST SPEED FORWARD
(No. 1 and No. 5 CLUTCHES ENGAGED)

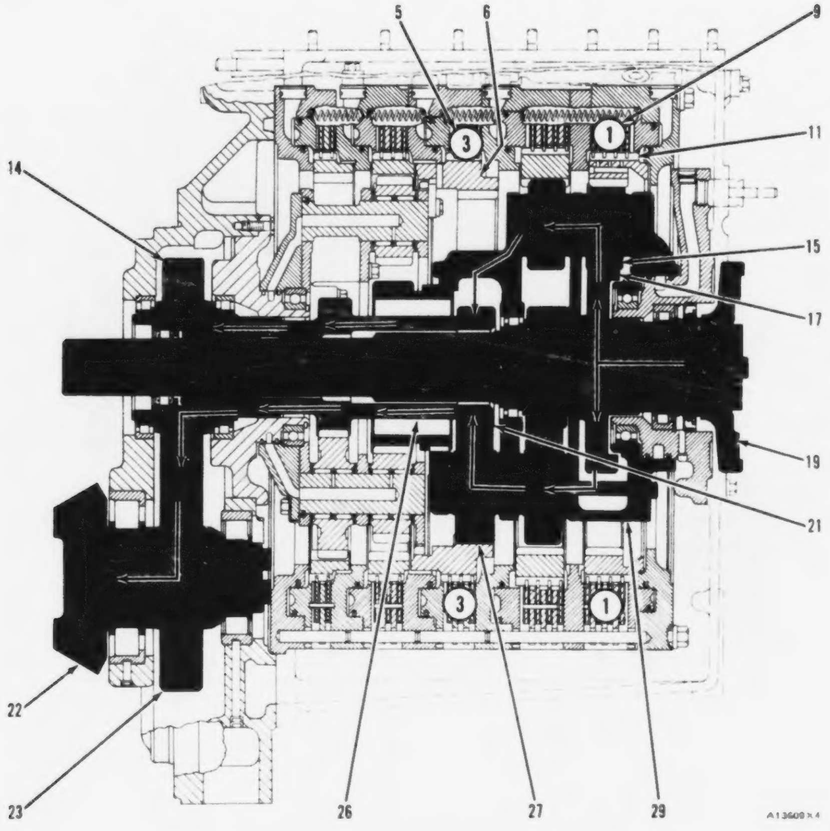
1. Ring gear for No. 5 clutch.
2. No. 5 clutch.
6. Ring gear for No. 3 clutch.
9. No. 1 clutch.
11. Ring gear for No. 1 clutch.
12. No. 2 carrier.
14. Transfer gear.
15. No. 1 planetary gears.
17. No. 1 sun gear.
18. No. 5 sun gear.
19. Input shaft.
21. No. 3 sun gear.
22. Bevel pinion.
23. Transfer gear.
24. No. 5 planetary gears.
26. Output shaft.
27. No. 3 planetary gears.
29. No. 1 carrier.

When the transmission is in FIRST SPEED FORWARD, No. 1 clutch (9) and No. 5 clutch (2) are engaged. The No. 1 clutch holds ring gear (11) for the No. 1 clutch stationary. The No. 5 clutch holds ring gear (1) for the No. 5 clutch stationary. Input shaft (19) turns No. 1 sun gear (17). The No. 1 sun gear turns No. 1 planetary gears (15).

Since the ring gear for the No. 1 clutch is held by the No. 1 clutch, planetary gears (15) move around the inside of the ring gear. The movement of planetary gears (15) causes No. 1 carrier (29) to turn in the same direction as input shaft (19). No. 1 carrier (29), No. 2 carrier (12) and ring gear (6) for the No. 3 clutch are connected mechanically. As the No. 1 carrier turns, No. 3 planetary gears (27) turn. The No. 3 planetary gears turn ring gear (6) for the No. 3 clutch and No. 3 sun gear (21). The No. 3 sun gear turns output shaft (26). Ring gear (6) turns No. 2 carrier (12). The No. 2 carrier turns No. 5 planetary gears (24).

Since ring gear (1) for the No. 5 clutch is held by the No. 5 clutch, No. 5 planetary gears (24) move around the inside of ring gear (1). The movement of the planetary gears and the No. 2 carrier turns No. 5 sun gear (18). The No. 5 sun gear also turns output shaft (26). As a result, the application of torque to output shaft (26) is divided through No. 5 sun gear (18) and No. 3 sun gear (21). From the output shaft, the power goes through gears (14) and (23) to bevel pinion (22).

SECOND SPEED FORWARD



POWER FLOW IN SECOND SPEED FORWARD
(No. 1 and No. 3 CLUTCHES ENGAGED)

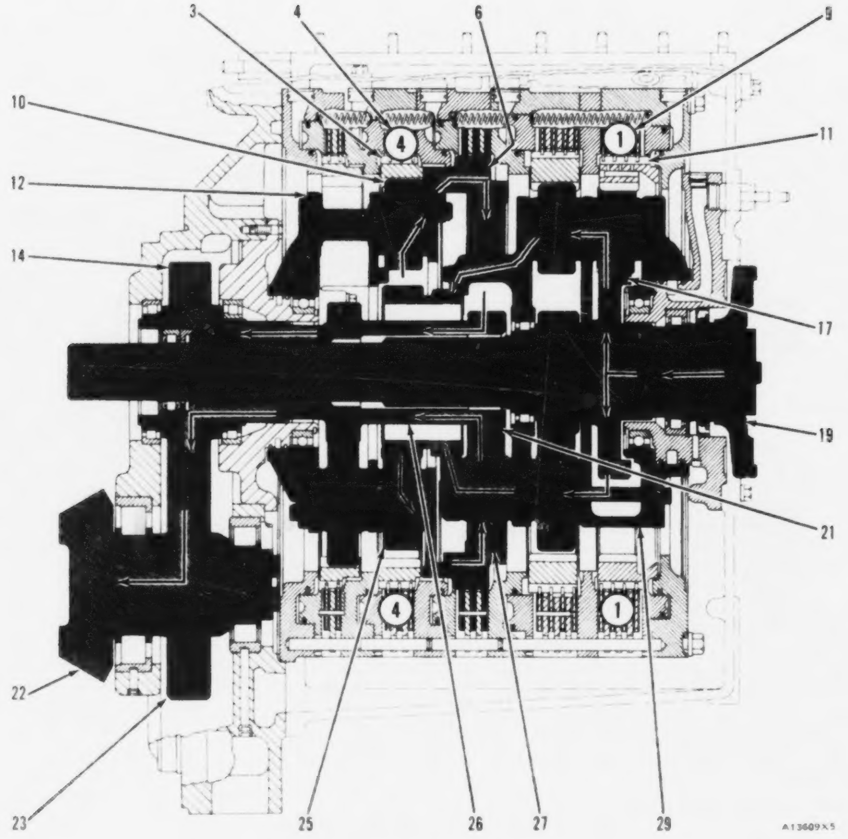
5. No. 3 clutch.
6. Ring gear for No. 3 clutch.
9. No. 1 clutch.
11. Ring gear for No. 1 clutch.
14. Transfer gear.
15. No. 1 planetary gears.
17. No. 1 sun gear.
19. Input shaft.
21. No. 3 sun gear.
22. Bevel pinion.
23. Transfer gear.
26. Output shaft.
27. No. 3 planetary gears.
29. No. 1 carrier.

When the transmission is in SECOND SPEED FORWARD, No. 1 clutch (9) and No. 3 clutch (5) are engaged. The No. 1 clutch holds ring gear (11) for the No. 1 clutch stationary. The No. 3 clutch holds ring gear (6) for the No. 3 clutch stationary. Input shaft (19) turns No. 1 sun gear (17). The No. 1 sun gear turns No. 1 planetary gears (15).

Since the ring gear for the No. 1 clutch is held by the No. 1 clutch, the planetary gears move around the inside of ring gear (11). The movement of the planetary gears causes the No. 1 carrier (29) to turn in the same direction as input shaft (19). As the No. 1 carrier turns, No. 3 planetary gears (27) turn.

Since ring gear (6) for the No. 3 clutch is held by the No. 3 clutch, planetary gears (27) move around the inside of ring gear (6). The movement of planetary gears (27) causes No. 3 sun gear (21) to turn. The No. 3 sun gear turns output shaft (26). From the output shaft, the power goes through gears (14) and (23) to bevel pinion (22).

THIRD SPEED FORWARD



POWER FLOW IN THIRD SPEED FORWARD
(No. 1 and No. 4 CLUTCHES ENGAGED)

3. Ring gear for No. 4 clutch.
4. No. 4 clutch.
6. Ring gear for No. 3 clutch.
9. No. 1 clutch.
10. No. 4 outer planetary gears.
11. Ring gear for No. 1 clutch.
12. No. 2 carrier.
14. Transfer gear.
17. No. 1 sun gear.
19. Input shaft.
21. No. 3 sun gear.
22. Bevel pinion.
23. Transfer gear.
25. No. 4 inner planetary gears.
26. Output shaft.
27. No. 3 planetary gears.
29. No. 1 carrier.

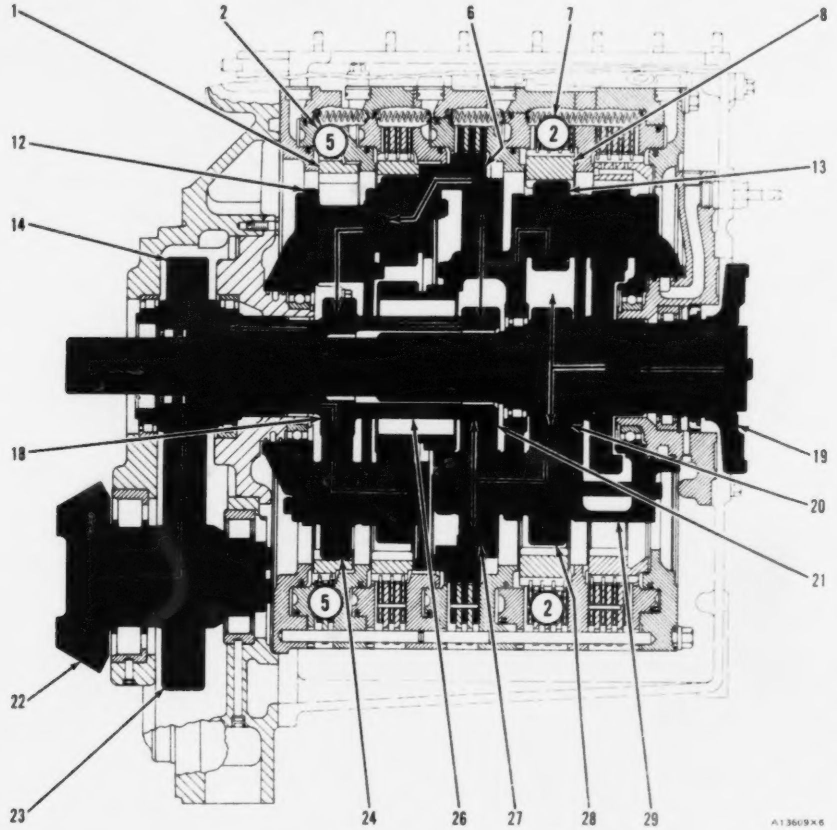
When the transmission is in THIRD SPEED FORWARD, the No. 1 clutch (9) and the No. 4 clutch (4) are engaged. The No. 1 clutch holds ring gear (11) for No. 1 clutch stationary. The No. 4 clutch holds ring gear (3) for the No. 4 clutch stationary. Input shaft (19) turns No. 1 sun gear (17). The No. 1 sun gear turns No. 1 planetary gears (15).

Since the ring gear for the No. 1 clutch is held by the No. 1 clutch, planetary gears (15) move around the inside of the ring gear. The movement of planetary gears (15) causes No. 1 carrier (29) to turn in the same direction as input shaft (19). The No. 4 sun gear (16) is connected to the No. 1 carrier. The No. 1 carrier turns the No. 4 sun gear. The No. 4 sun gear turns No. 4 inner planetary gears (25). The planetary gears (25) turn No. 4 outer planetary gears (10).

Since ring gear (3) for the No. 4 clutch is held by the No. 4 clutch, planetary gears (10) move around the inside of the ring gear. The movement of planetary gears (10) causes No. 2 carrier (12) to turn in the opposite direction as No. 1 carrier (29).

Since ring gear (6) for the No. 3 clutch is connected to the No. 2 carrier, the No. 2 carrier turns ring gear (6). The ring gear turns No. 3 planetary gears (27). The No. 3 planetary gears turn No. 3 sun gear (21) in the same direction as the No. 1 carrier and the input shaft. The No. 3 sun gear turns output shaft (26). From the output shaft, the power goes through gears (14) and (23) to bevel pinion (22).

FIRST SPEED REVERSE



POWER FLOW IN FIRST SPEED REVERSE
(No. 2 and No. 5 CLUTCHES ENGAGED)

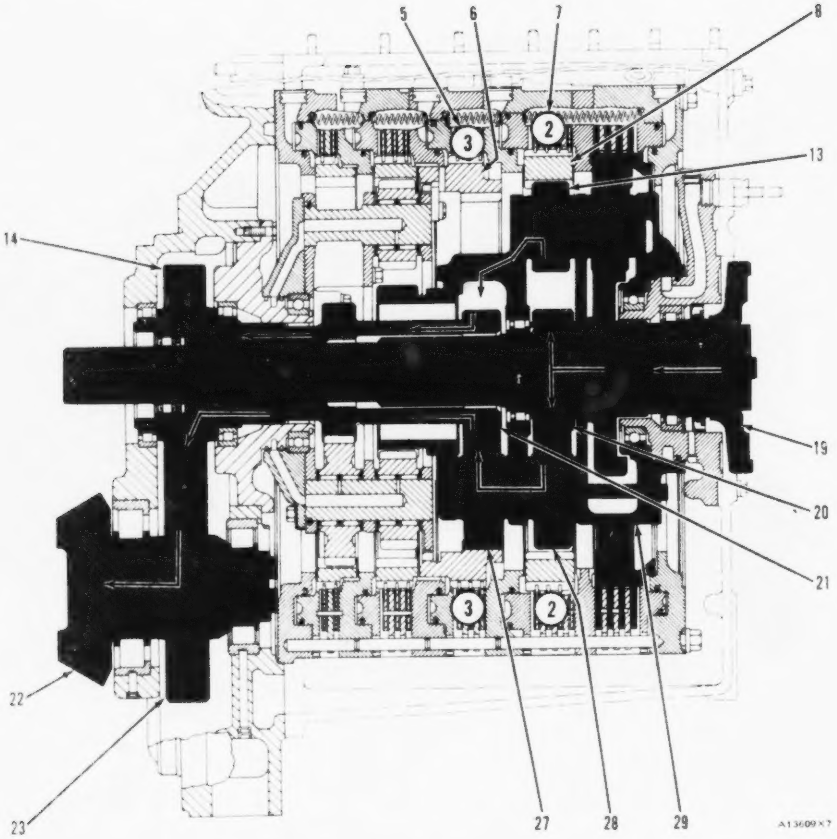
1. Ring gear for No. 5 clutch.
2. No. 5 clutch.
6. Ring gear for No. 3 clutch.
7. No. 2 clutch.
8. Ring gear for No. 2 clutch.
12. No. 2 carrier.
13. No. 2 outer planetary gears.
14. Transfer gear.
18. No. 5 sun gear.
19. Input shaft.
20. No. 2 sun gear.
21. No. 3 sun gear.
22. Bevel pinion.
23. Transfer gear.
24. No. 5 planetary gears.
26. Output shaft.
27. No. 3 planetary gears.
28. No. 2 inner planetary gears.
29. No. 1 carrier.

When the transmission is in FIRST SPEED REVERSE, No. 2 clutch (7) and No. 5 clutch (2) are engaged. The No. 2 clutch holds ring gear (8) for the No. 2 clutch stationary. The No. 5 clutch holds ring gear (1) for the No. 5 clutch stationary. Input shaft (19) turns No. 2 sun gear (20). The No. 2 sun gear turns No. 2 inner planetary gears (28). Planetary gears (28) turn No. 2 outer planetary gears (13).

Since ring gear (8) for the No. 2 clutch is held by the No. 2 clutch, planetary gears (13) move around the inside of the ring gear. The movement of planetary gears (13) causes No. 1 carrier (29) to turn in the opposite direction as input shaft (19). No. 1 carrier (29), No. 2 carrier (12) and ring gear (6) for the No. 3 clutch are connected mechanically. As the No. 1 carrier turns, No. 3 planetary gears (27) turn. The No. 3 planetary gears turn ring gear (6) for the No. 3 clutch and No. 3 sun gear (21). The No. 3 sun gear turns output shaft (26) in the opposite direction as input shaft (19). Ring gear (6) turns No. 2 carrier (12). The No. 2 carrier turns No. 5 planetary gears (24).

Since ring gear (1) for the No. 5 clutch is held by the No. 5 clutch, No. 5 planetary gears (24) move around the inside of ring gear (1). The movement of planetary gears (24) and No. 2 carrier (12) turns No. 5 sun gear (18). The No. 5 sun gear also turns output shaft (26) in the opposite direction as input shaft (19). As a result, the application of torque to output shaft (26) is divided through No. 5 sun gear (18) and No. 3 sun gear (21). From the output shaft, the power goes through gears (14) and (23) to bevel pinion (22).

SECOND SPEED REVERSE



POWER FLOW IN SECOND SPEED REVERSE
(No. 2 and No. 3 CLUTCHES ENGAGED)

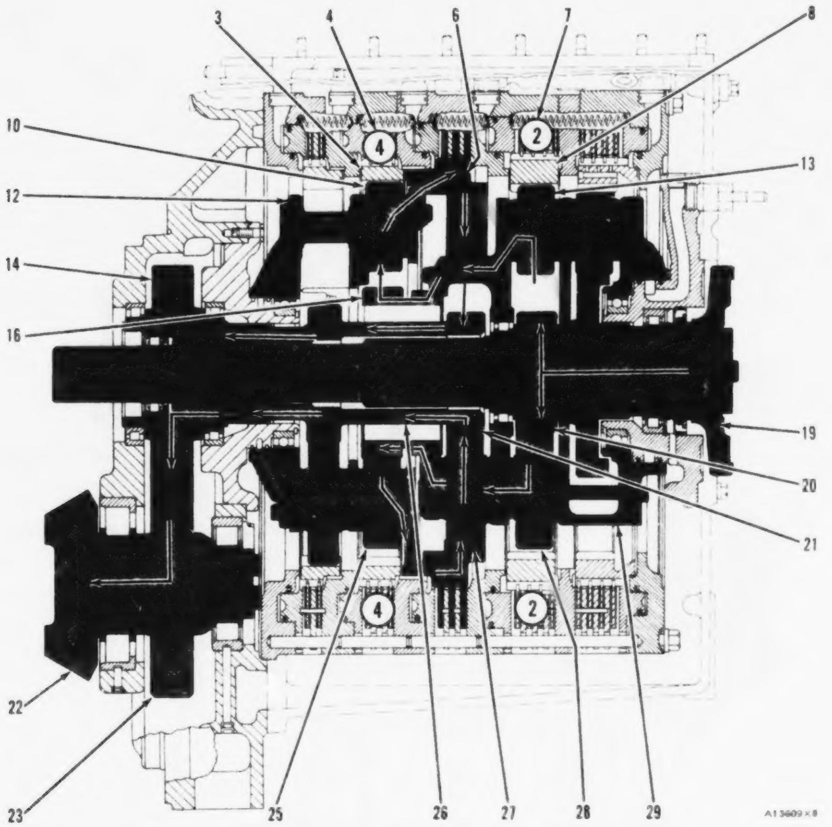
5. No. 3 clutch.
6. Ring gear for No. 3 clutch.
7. No. 2 clutch.
8. Ring gear for No. 2 clutch.
13. No. 2 outer planetary gears.
14. Transfer gear.
19. Input shaft.
20. No. 2 sun gear.
21. No. 3 sun gear.
22. Bevel pinion.
23. Transfer gear.
27. No. 3 planetary gears.
28. No. 2 inner planetary gears.
29. No. 1 carrier.

When the transmission is in SECOND SPEED REVERSE, No. 2 clutch (7) and No. 3 clutch (5) are engaged. The No. 2 clutch holds ring gear (8) for the No. 2 clutch stationary. The No. 3 clutch holds ring gear (6) for the No. 3 clutch stationary. Input shaft (19) turns No. 2 sun gear (20). The No. 2 sun gear turns No. 2 inner planetary gears (28). Planetary gears (28) turn No. 2 outer planetary gears (13).

Since ring gear (8) for the No. 2 clutch is held by the No. 2 clutch, planetary gears (13) move around the inside of the ring gear. The movement of planetary gears (13) causes No. 1 carrier (29) to turn in the opposite direction as input shaft (19). As the No. 1 carrier turns, No. 3 planetary gears (27) turn.

Since ring gear (6) for the No. 3 clutch is held by the No. 3 clutch, planetary gears (27) move around the inside of ring gear (6). The movement of planetary gears (27) causes No. 3 sun gear (21) to turn. The No. 3 sun gear turns output shaft (26) in the opposite direction as input shaft (19). From the output shaft, the power goes through gears (14) and (23) to bevel pinion (22).

THIRD SPEED REVERSE



POWER FLOW IN THIRD SPEED REVERSE
(No. 2 and No. 4 CLUTCHES ENGAGED)

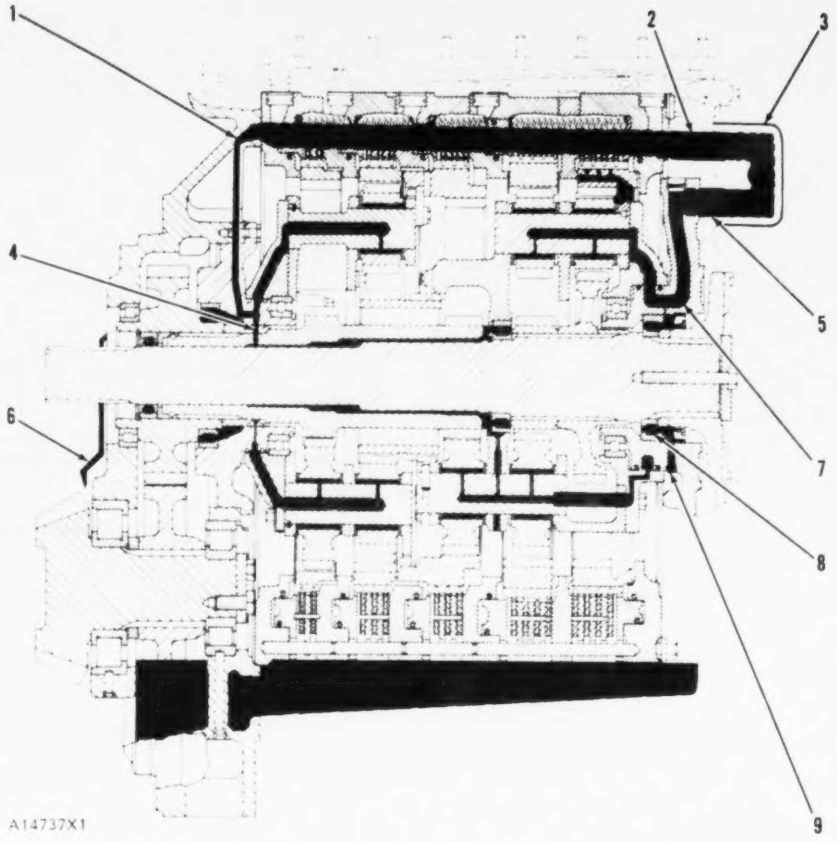
3. Ring gear for No. 4 clutch.
4. No. 4 clutch.
6. Ring gear for No. 3 clutch.
7. No. 2 clutch.
8. Ring gear for No. 2 clutch.
10. No. 4 outer planetary gears.
12. No. 2 carrier.
13. No. 2 outer planetary gears.
14. Transfer gear.
16. No. 4 sun gear.
19. Input shaft.
20. No. 2 sun gear.
21. No. 3 sun gear.
22. Bevel pinion.
23. Transfer gear.
25. No. 4 inner planetary gears.
26. Output shaft.
27. No. 3 planetary gears.
28. No. 2 inner planetary gears.
29. No. 1 carrier.

When the transmission is in THIRD SPEED REVERSE, No. 2 clutch (7) and No. 4 clutch (4) are engaged. The No. 2 clutch holds ring gear (8) for the No. 2 clutch stationary. The No. 4 clutch holds ring gear (3) for the No. 4 clutch stationary. Input shaft (19) turns No. 2 sun gear (20). The No. 2 sun gear turns No. 2 inner planetary gears (28). Planetary gears (28) turn No. 2 outer planetary gears (13).

Since ring gear (8) for the No. 2 clutch is held by the No. 2 clutch, planetary gears (13) move around the inside of the ring gear. The movement of planetary gears (13) causes No. 1 carrier (29) to turn in the opposite direction as input shaft (19). No. 4 sun gear (16) is connected to the No. 1 carrier. The No. 1 carrier turns the No. 4 sun gear. The No. 4 sun gear turns No. 4 inner planetary gears (25). Planetary gears (25) turn No. 4 outer planetary gears (10).

Since ring gear (3) for the No. 4 clutch is held by the No. 4 clutch, planetary gears (10) move around the inside of the ring gear. The movement of planetary gears (10) causes No. 2 carrier (12) to turn in the opposite direction of No. 1 carrier (29). Since ring gear (6) for the No. 3 clutch is connected to the No. 2 carrier, the No. 2 carrier turns ring gear (6). The ring gear turns No. 3 planetary gears (27). The No. 3 planetary gears turn No. 3 sun gear (21) in the same direction as the No. 1 carrier. The No. 3 sun gear turns output shaft (26) in the opposite direction as input shaft (19). From the output shaft, the power goes through gears (14) and (23) to bevel pinion (22).

TRANSMISSION LUBRICATION



TRANSMISSION LUBRICATION

1. Passage. 2. Tube. 3. Transmission lubrication manifold. 4. Passage. 5. Tube. 6. Tube. 7. Manifold. 8. Front bearing. 9. Passage.

The oil for lubrication of the transmission comes from the oil pump on the torque divider case.

From the pump, the oil goes to manifold (3) on the front of the transmission case. The manifold divides the flow of oil. The oil is sent through tubes (2) and (5).

The oil in tube (5) goes into manifold (7) in the front bearing cage. The manifold sends oil through a passage to the No. 1 carrier. The oil then goes to the bearings for the planetary gears and the center bearing of the input shaft. A small passage in the front bearing cage lets oil go to front bearing (8). This oil then goes through passage (9) to the bottom of the transmission case.

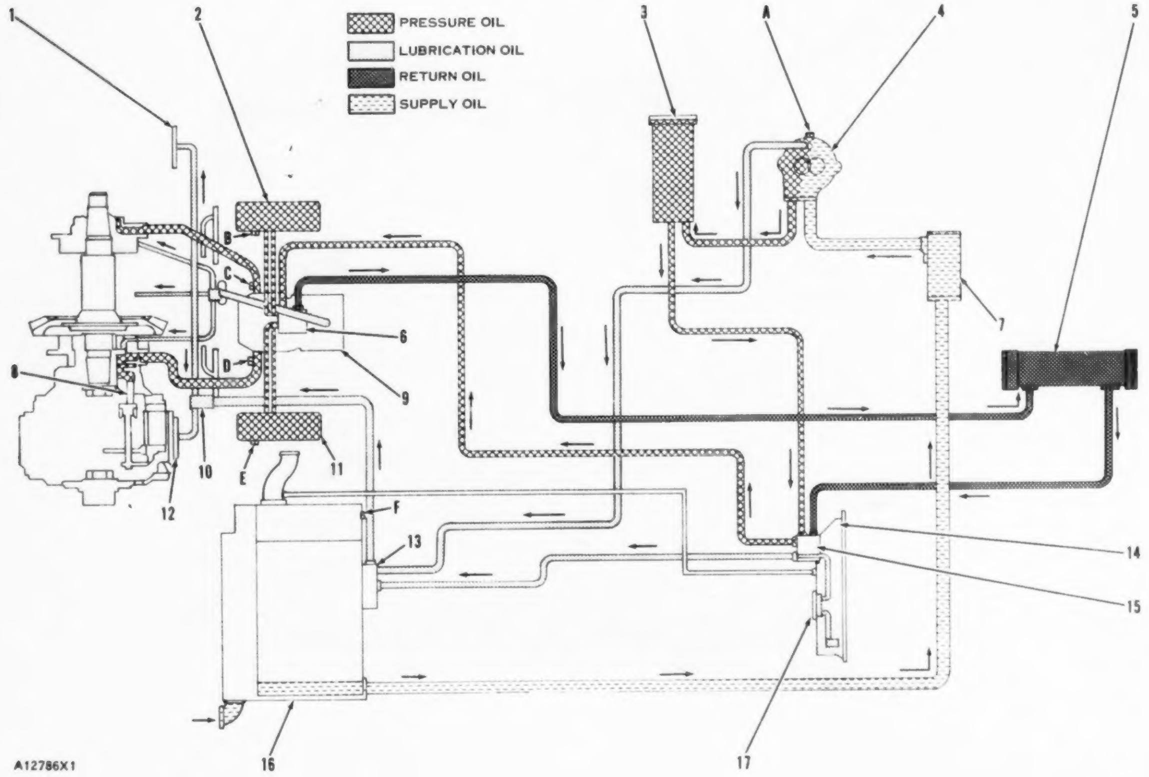
The oil in tube (2) goes through a passage in each clutch housing to passage (1) in the transfer gear case. Some of the oil goes through a passage to the No. 2 carrier. This oil is for lubrication of the bearings for the planetary gears. The remainder of the oil goes through tube (6) for lubrication of the bevel gear and through passage (4) for lubrication of the rear bearing.

A passage in each of the clutch housings lets some oil go to the clutch discs and plates for cooling and lubrication.

The remainder of the components in the transmission get lubrication from oil thrown inside the transmission and oil released from points of pressure lubrication.

HYDRAULIC SYSTEM

(DIRECT DRIVE)



SCHEMATIC OF THE HYDRAULIC SYSTEM

1. Left brake band. 2. Hydraulic control mechanism for the left brake. 3. Oil filter. 4. Transmission oil pump. 5. Oil cooler. 6. Relief valve for the hydraulic controls for the steering clutches and brakes. 7. Magnetic strainer. 8. Steering clutch piston. 9. Hydraulic control valve for the steering clutches. 10. Relief valve for brake cooling and lubrication. 11. Hydraulic control mechanism for the right brake. 12. Right brake band. 13. Oil manifold for transmission lubrication. 14. Flywheel clutch. 15. Hydraulic control mechanism for the flywheel clutch. 16. Transmission case. 17. Oil pump. A. Pressure tap for transmission oil pump. B. Pressure tap for hydraulic control mechanism for left brake. C. Pressure tap for left steering clutch. D. Pressure tap for right steering clutch. E. Pressure tap for hydraulic control mechanism for right brake. F. Pressure tap for transmission lubrication.

The hydraulic system has a common reservoir. It gives lubrication oil for the bevel gear and pinion and transmission, and cooling oil for the flywheel clutch, steering clutches and brakes. It also gives pressure oil for the operation of the hydraulic control mechanism for the flywheel clutch and the hydraulic controls for the steering clutches and brakes.

Oil is pulled from the reservoir in the bevel gear case through magnetic strainer (7) by pump (4). An oil line goes from pump (4) to the manifold (13) for transmission lubrication. When the engine is first started, this line lets any air on the suction side of the pump go out of the pump. The operation of the pump starts faster. After the engine is running, this oil line lets a specific amount of oil go to the manifold (13).

The pump (4) sends pressure oil to oil filter (3). The oil goes through the filter to relief valve (6). If the oil filter has restrictions, a bypass valve in the filter housing lets the oil go directly to relief valve (6).

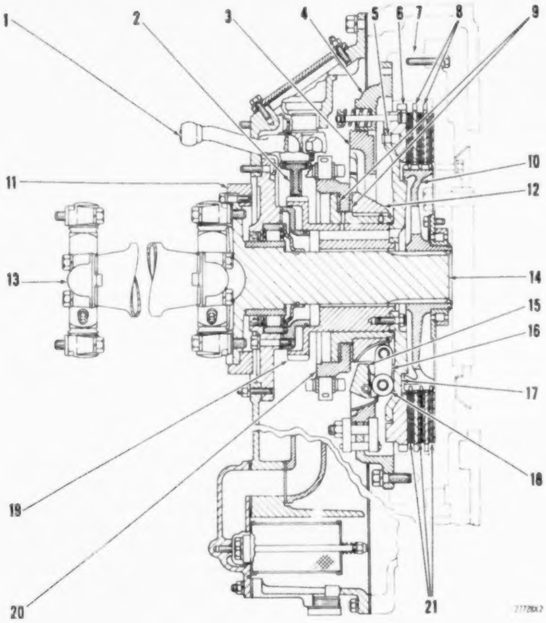
Relief valve (6) sends pressure oil to the hydraulic controls for the steering clutches and brakes. Any oil not used by the steering clutches or brakes is sent to oil cooler (5). If there are restrictions to the flow of the oil, relief valve (6) will open and let the oil go to oil cooler (5).

The hydraulic controls for the steering clutches and brakes give oil for the operation of the steering clutches and the hydraulic control mechanisms for the brakes. When the steering clutches are engaged, oil goes through relief valve (6) to oil cooler (5). A small amount of oil goes from the relief valve through an orifice. This oil is for the lubrication of the hydraulic controls, bevel gear, and bearings for the bevel gear shaft.

Oil from oil cooler (5) is sent to hydraulic control mechanism (15) for the flywheel clutch. This oil is for the operation of the hydraulic control mechanism and for flywheel clutch lubrication. Extra oil goes to the bottom of the flywheel clutch housing. Oil pump (17) pulls the oil from the bottom of the housing through a screen. The oil pump then sends the oil to manifold (13). The manifold sends oil to transmission (16) for lubrication of the gears and bearings. Oil is also sent through a line to the right and left brake bands for cooling.

FLYWHEEL CLUTCH
(DIRECT DRIVE)

The flywheel clutch is operated manually and is an oil type. The flywheel clutch and transmission have a common supply of oil. The lubrication and cooling of the flywheel clutch is done by oil from the oil pump for the flywheel clutch. Three driven discs (21) and drive plates (6) and (8) send the power from the engine to the transmission. The action of a cam link and roller assembly against a plate keeps the clutch engaged. A brake on the clutch shaft is activated when the clutch is released. When the clutch is fully released, the rotation of the clutch shaft and the upper shaft of the transmission is stopped.



FLYWHEEL CLUTCH

1. Lever. 2. Idler gear. 3. Adjustment ring. 4. Bracket. 5. Dowel. 6. Drive plate. 7. Flywheel. 8. Drive plates. 9. Thrust washers. 10. Hub. 11. Brake drum. 12. Collar. 13. Universal joint. 14. Clutch shaft. 15. Link. 16. Link. 17. Plate. 18. Roller. 19. Hub. 20. Collar. 21. Driven discs.

Drive plates (6) and (8) have teeth on the outer edge. The teeth are engaged with the teeth on the inside of flywheel (7). Driven plates (21) have teeth on the inside edge. The teeth are engaged with the teeth on the outside of hub (10). Splines connect hub (10) to clutch shaft (14). One end of the clutch shaft is a drive flange. The drive flange is connected to universal joint (13). The universal joint is connected to the upper shaft of the transmission. Dirt is kept out of the clutch housing by an oil seal on the end of the clutch shaft. The oil seal also keeps oil in the clutch housing. The drive flange end of the clutch shaft is held by a bearing. The front end of the clutch shaft is in the center of hub (10) and is held in the center of flywheel (7) by a bearing.

An oil pump is fastened to the flywheel clutch housing. It pulls oil from the bottom of the flywheel clutch housing through a screen. The oil is used for the lubrication and cooling of the flywheel clutch.

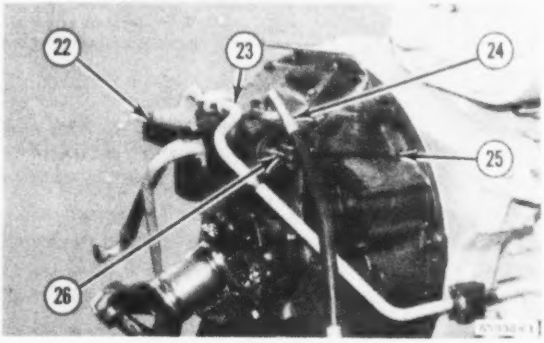
Coupling (28) is installed in piston (39). The coupling is connected to the lever (1) of the flywheel clutch. When piston (39) moves, coupling (28) and lever (1) move. As the coupling and the lever are moved, collar (20) moves against collar (12). Collar (12) is connected to adjustment ring (3) by links (15) and (16). There are six of these links.

Bracket (4) is fastened to flywheel (7). The adjustment ring (3) is fastened to bracket (4) by threads.

As collar (12) moves forward, rollers (18) push against plate (17). This pushes drive plate (6) against drive plate (8) and driven plates (21). One of the driven plates makes contact with the face of the flywheel. The flywheel turns the driven plates.

The oil pump is driven by drive plate (6) through dowel (5), plate (17), hub (19) and idler gear (2).

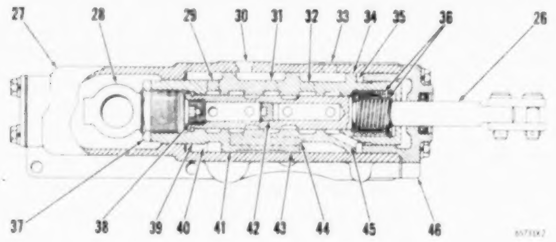
The hydraulic control mechanism (22) gives assistance to the operator when the flywheel clutch is engaged or released.



HYDRAULIC CONTROL FOR THE FLYWHEEL CLUTCH

22. Hydraulic control mechanism. 23. Supply line. 24. Return to transmission reservoir. 25. Bellcrank. 26. Valve spool.

The hydraulic control mechanism is a two direction valve. Valve spool (26) moves to the left when the flywheel clutch is released (not engaged) and to the right when the flywheel clutch is engaged. The valve spool has a positive mechanical connection with the control lever for the flywheel clutch. Bellcrank (25) is connected to the control lever for the flywheel clutch. Valve spool (26) is connected to the bellcrank. When the control lever is moved, the bellcrank and the valve spool move. The remainder of the action in the hydraulic control mechanism is hydraulically operated. Since valve spool (26) is mechanically connected to the control lever and piston (39) is not, the valve spool moves before the piston moves.



HYDRAULIC CONTROL MECHANISM

26. Valve spool. **27.** Valve body. **28.** Coupling. **29.** Passage. **30.** Supply passage. **31.** Passage. **32.** Passage. **33.** Return passage. **34.** Land. **35.** Chamber. **36.** Springs. **37.** Adjustment nut. **38.** Plug. **39.** Piston. **40.** Chamber. **41.** Land. **42.** Plug. **43.** Land. **44.** Passage. **45.** Passage. **46.** Cover.

Supply oil for the operation of the hydraulic control mechanism comes from the transmission oil pump.

Oil from the transmission oil pump goes into the hydraulic control mechanism through supply passage (30).

When the control lever for the flywheel clutch is moved and the flywheel clutch is released, the operation of the hydraulic control mechanism is as follows:

Valve spool (26) moves to the left. Since the valve spool moves faster than piston (39), passage (31) is opened. Oil goes through passages (30) and (31) into the center of valve spool (26) at the right of plug (42). The oil goes through the valve spool and into passage (45) and starts to fill chamber (35). As chamber (35) fills, the oil pushes against land (34) and cover (46). This action moves the piston (39) to the left. The force of the oil against the piston is what gives the operator the assistance to release the flywheel clutch.

When valve spool (26) moves to the left, it also opens chamber (40) through passage (44) to return passage (33). This lets the oil in chamber (40) go to the reservoir. Since the left end of piston (39) is open to the reservoir and there is pressure on the right end of the piston, the piston will move to the left. When the piston moves, valve spool (26) does not let the oil go into passage (45) and chamber (35). At this time, the flywheel clutch is released.

When the control lever for the flywheel clutch is moved and the flywheel clutch is engaged, the operation of the hydraulic control is as follows:

Valve spool (26) moves to the right. Since the valve spool moves faster than piston (39), passage (31) is opened. Oil goes through passages (30) and (31) into the center of valve spool (26) between plugs (38) and (42). The oil goes through the valve spool and into passage (29). The oil goes through passage (29) and starts to fill chamber (40). As chamber (40) fills, the oil pushes against the left end of the chamber and land (41). This action moves the piston (39) to the right. The force of the oil against the piston is what gives the operator the assistance to engage the flywheel clutch.

When the valve spool (26) moves to the right, it also opens chamber (35) through passage (45) to return passage (33). The oil in chamber (35) then goes to the reservoir. Since the right end of piston (39) is open to the reservoir and there is pressure on the left end of piston (39), the piston will move to the right. When the piston moves, valve spool (26) does not let the oil go into passage (29) and chamber (40). At this time, the flywheel clutch is engaged.

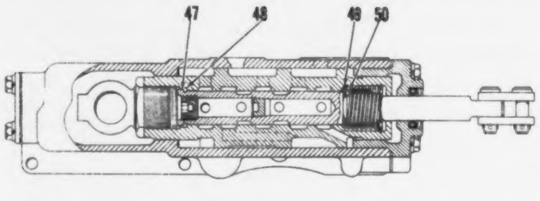
After the flywheel clutch has been engaged or released, the operation of the hydraulic control mechanism is as follows:

At this time, valve spool (26) closes passage (31). Oil does not go into the center of the valve spool. When the valve spool is in this position, the oil that comes in supply passage (30) is sent through a line to the relief valve for the steering clutches. From the relief valve for the steering clutches, the oil goes to the oil cooler. After the oil goes through the oil cooler, it goes back to the hydraulic control mechanism for the flywheel clutch. Line (24) sends the oil to the oil manifold on the transmission. This oil is for the lubrication of the transmission, steering clutches, and brake bands. The oil then goes to the reservoir.

The flywheel clutch can also be operated manually. When the clutch is released, valve spool (26) moves to the left. The movement of the valve spool causes a compression of the springs (36). The compression of the springs lets washer (49) push against spacer (50). This moves piston (39) to the left. Coupling (28) and lever (1) move and release the flywheel clutch.

FLYWHEEL CLUTCH
(Direct Drive)

When the clutch is engaged, valve spool (26) moves to the right. Lip (47) makes a contact with land (48). This moves piston (39) to the right. Coupling (28) and lever (1) move and engage the clutch.



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HYDRAULIC CONTROL MECHANISM

47. Lip on valve spool. **48.** Land. **49.** Washer. **50.** Spacer.

GEARSHIFT AND INTERLOCK MECHANISM

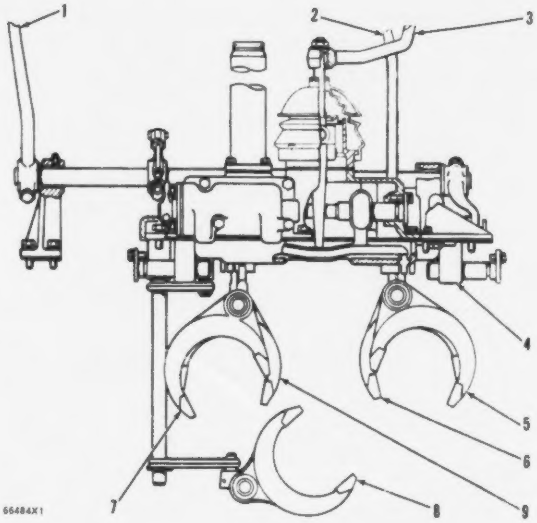
(DIRECT DRIVE)

There are two control levers for the transmission and one control lever for the flywheel clutch. The gearshift and interlock mechanism is on the top part of the transmission case. The control lever for the flywheel clutch is fastened to the tractor frame.

The gearshift and interlock mechanism holds the shift forks and transmission gears in position when the flywheel clutch is engaged. It also prevents the transmission from being put in more than one speed at a time.

The selection of FORWARD or REVERSE is made by lever (2). The selection of the speed is made by lever (3). The different positions of levers (2) and (3) gives the transmission six speeds FORWARD and six speeds REVERSE.

The positions of forks (5), (6), (7) and (8) are controlled by lever (3). The positions of fork (8) are controlled by lever (2).

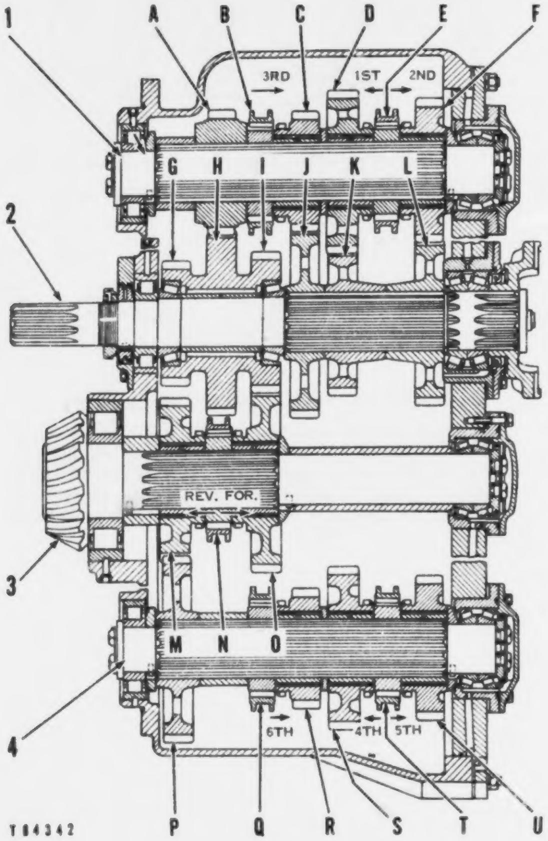


GEARSHIFT AND INTERLOCK MECHANISM

1. Control lever for flywheel clutch. 2. Control lever for direction selection. 3. Control lever for speed selection. 4. Gate. 5. Shift fork for sixth speed. 6. Shift fork for fourth and fifth speeds. 7. Shift fork for third speed. 8. Shift fork for direction selection. 9. Shift fork for first and second speeds.

TRANSMISSION
(DIRECT DRIVE)

The transmission has six speeds FORWARD and six speeds REVERSE. The selection of the direction is done by the direction lever. The direction lever is connected through a shift fork to collar (N). The selection of the speed is done by the speed lever. The speed lever is connected through four shift forks to collars (B), (E), (Q) and (T).



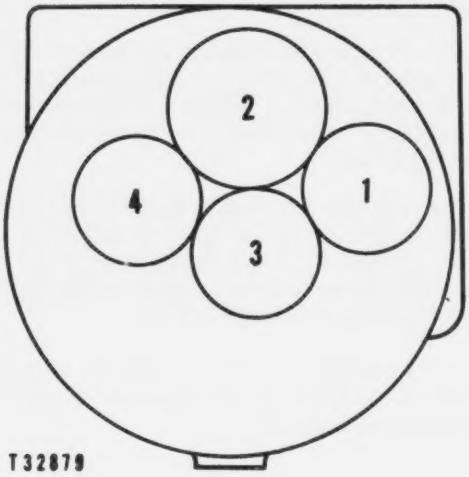
TRANSMISSION

1. Left countershaft. 2. Upper shaft. 3. Pinion shaft. 4. Right countershaft. A. Gear. B. Collar. C. Third speed gear. D. First speed gear. E. Collar. F. Second speed gear. G. Gear. H. Gear. I. Gear. J. Gear. K. Gear. L. Gear. M. Reverse gear. N. Collar. O. Forward gear. P. Gear. Q. Collar. R. Sixth speed gear. S. Fourth speed gear. T. Collar. U. Fifth speed gear.

The left countershaft (1) is on the left side of the transmission between the upper shaft (2) and pinion shaft (3). With this arrangement, gears (A) and (H), (C) and (J), (D) and (K), and (F) and (L) are engaged all the time.

Right countershaft (4) is on the right side of the transmission between upper shaft (2) and pinion shaft (3). With this arrangement, gears (G) and (P) and (M), (J) and (R), (K) and (S), and (L) and (U) are engaged all the time.

Gears (C), (D) and (F) on left countershaft (1) and gears (R), (S) and (U) on right countershaft (4) are used for both FORWARD and REVERSE speeds.



LOCATIONS OF SHAFTS (FRONT VIEW)

1. Left countershaft. 2. Upper shaft. 3. Pinion shaft. 4. Right countershaft.

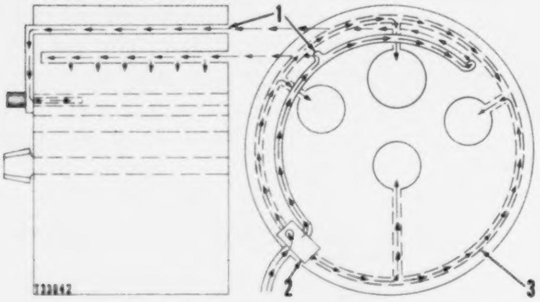
First speed gear (D) and second speed gear (F) are engaged by collar (E). Third speed gear (C) is engaged by collar (B). Fourth speed gear (S) and fifth speed gear (U) are engaged by collar (T). Sixth speed gear (R) is engaged by collar (Q). Collar (N) engages gear (10) for all speeds FORWARD and gear (M) for all speeds REVERSE.

The chart that follows gives the power flow through the transmission for each speed.

SPEED	POWER FLOW							
1st Forward	K-D	D-E	E-A	A-H	H-I	I-O	O-N	
2nd Forward	L-F	F-E	E-A	A-H	H-I	I-O	O-N	
3rd Forward	J-C	C-B	B-A	A-H	H-I	I-O	O-N	
4th Forward	K-S	S-T	T-P	P-G	G-I	I-O	O-N	
5th Forward	L-U	U-T	T-P	P-G	G-I	I-O	O-N	
6th Forward	J-R	R-Q	Q-P	P-G	G-I	I-O	O-N	
1st Reverse	K-D	D-E	E-A	A-H	H-G	G-P	P-M	M-N
2nd Reverse	L-F	F-E	E-A	A-H	H-G	G-P	P-M	M-N
3rd Reverse	J-C	C-B	B-A	A-H	H-G	G-P	P-M	N-N
4th Reverse	K-S	S-T	T-P	P-M	M-N			
5th Reverse	L-U	U-T	T-P	P-M	M-N			
6th Reverse	J-R	R-Q	Q-P	P-M	M-N			

TRANSMISSION LUBRICATION

The oil for the lubrication of the transmission comes from an oil pump fastened to the bottom of the flywheel clutch housing. The oil is sent from the oil pump to manifold (2) for transmission lubrication. The manifold is on the transmission front cover.

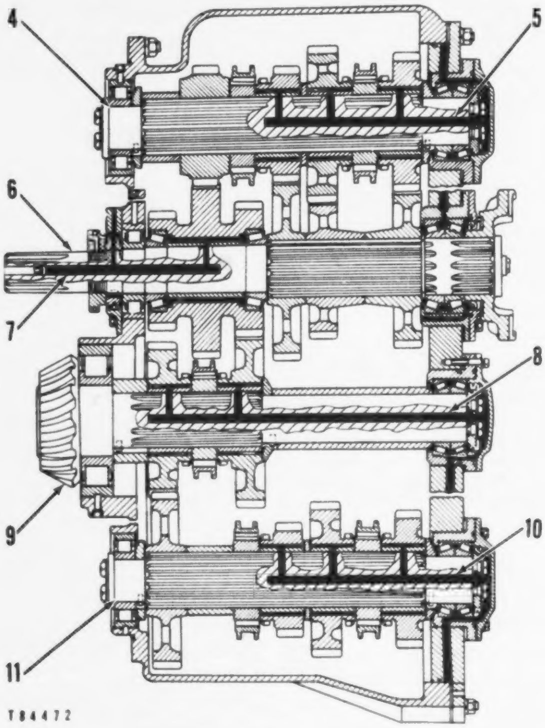


SCHEMATIC OF LUBRICATION SYSTEM

1. Manifolds. 2. Manifold for transmission lubrication. 3. Passage.

Part of the oil from manifold (2) goes through a passage (3) in the transmission front cover to the forward bearings on upper shaft (6), pinion shaft (9) and two countershafts (4) and (11). The oil goes through passage (8) in pinion shaft (9) and through the passages (5) and (10) in two countershafts (4) and (11). The oil in passages (5), (8) and (10) goes through holes in the shafts. The oil goes to the bearings on the gears on the shafts. The roller bearings on the rear of the shafts get lubrication from oil thrown from the bottom of the transmission case.

The remainder of the oil from manifold (2) goes to manifolds (1). The manifolds (1) are hollow shafts that go through the transmission. The oil goes through the manifolds. Holes in the manifolds let the oil go onto the teeth of the gears on upper shaft (6), pinion shaft (9) and two countershafts (4) and (11). Oil is also sent through the left manifold to passage (7). The oil goes through passage (7) to the idler gear bearings.

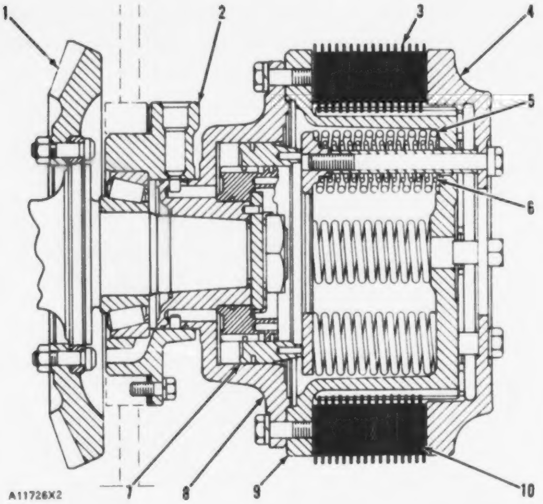


TRANSMISSION LUBRICATION

4. Left countershaft. 5. Passage. 6. Upper shaft. 7. Passage. 8. Passage. 9. Pinion shaft. 10. Passage. 11. Right countershaft.

STEERING CLUTCHES, BRAKES AND FINAL DRIVES

STEERING CLUTCHES AND FINAL DRIVES



STEERING CLUTCH

1. Bevel gear. 2. Bearing cage. 3. Disc assemblies. 4. Pressure plate. 5. Outer springs. 6. Inner springs. 7. Piston. 8. Hub. 9. Steering clutch inner drum. 10. Steel discs.

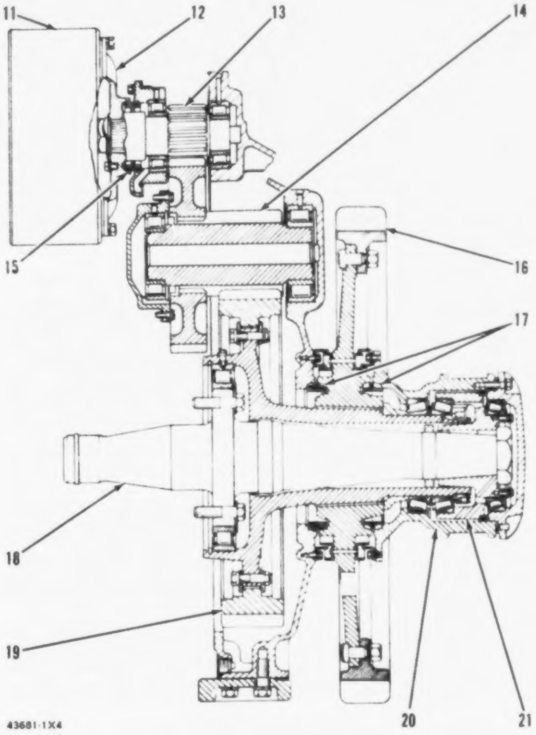
The main components of the steering clutches and final drives are: bevel gear (1), bevel gear shaft, steering clutch inner drum (9), disc assemblies (3), steel discs (10), steering clutch outer drum (11) [also the brake drum], final drive pinion (13), idler pinion (14), final drive gear (19), sprocket shaft (18) and sprocket (16).

The bevel gear and steering clutches are in the bevel gear and steering clutch case. The bevel gear case is the reservoir for the transmission and steering hydraulic systems. As the bevel gear turns, lubricant is thrown on the bevel gear, bevel pinion and steering clutches for lubrication. The bearings for the bevel gear shaft get lubrication from the control valve for the steering clutches.

The final drive cases are fastened to the bevel gear and steering clutch case. The final drive cases are reservoirs for oil for the final drives.

With a steering clutch engaged, the force of springs (5) and (6) keeps pressure plate (4), steel discs (10) and disc assemblies (3) against inner drum (9). Power goes from the inner drum, through the discs, to the outer drum. The steering clutches are normally engaged.

With a steering clutch released, pressure oil from the hydraulic controls for the steering clutches moves piston (7) toward the outside of the machine. The piston pushes on the spring retainer. The spring retainer pushes on springs (5) and (6) and puts them in compression. At the same time, the spring retainer pushes pressure plate (4) toward the outside of the machine. The pressure plate is now not in contact with steel discs (10) and disc assemblies (3). The disc and disc assemblies are not held together. Power can not go from the inner drum to the outer drum.



FINAL DRIVE

11. Steering clutch outer drum. 12. Hub. 13. Final drive pinion. 14. Idler pinion. 15. Duo-Cone seals. 16. Sprocket. 17. Duo-Cone seals. 18. Sprocket shaft. 19. Final drive gear. 20. Support. 21. Bearing cage.

Splines connect both ends of the bevel gear shaft to a drive hub. The drive hubs are fastened to inner drums (9) of the steering clutches. Teeth connect steel discs (10) to the inner drums. Teeth connect disc assemblies (3) to outer drum (11). The outer drum is fastened to the final drive hub of pinion (13). Pinion (13) is engaged with idler gear (14). The idler gear is engaged with final drive gear (19). Splines connect sprocket (16) to the final drive gear. The teeth of the sprocket are engaged with the track pins.

When a steering clutch is engaged, the flow of power is: From the bevel gear (1), through bevel gear shaft to inner drum (9). The inner drum turns steel discs (10). The steel discs turn disc assemblies (3). The disc assemblies turn outer drum (11). The outer drum turns final drive pinion (13). The final drive pinion turns idler gear (14). The idler gear turns gear (19). The gear turns sprocket (16). The sprocket turns the track.

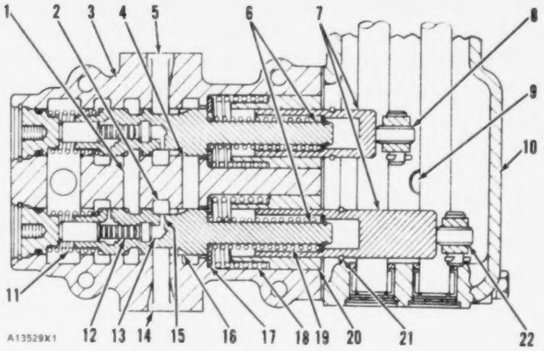
When a steering clutch is not engaged, the connection between bevel gear (1) and final drive pinion (13) is broken. Power does not go through the final drive to the track.

Lubrication of the Final Drives

Each final drive has its own separate lubrication system. Each system has a gear pump, a check valve with a gravity ball an a filter. The pump sends the oil through a strainer and a line to the check valve with a gravity ball and a filter. The pump sends stopped by the filter, from going with the oil back through the pump when the machine is operated in REVERSE. The oil goes from the check valve to the filter. The oil then goes through the filter to a junction. A bypass valve in the filter lets oil go by the filter if the oil can not go through the filter. At the junction, the oil goes in two separate lines. One line lets the oil go to a point above final drive pinion (13). This oil is for the lubrication of the final drive pinion and pinion bearings. The other line lets oil go in a passage in the center of sprocket shaft (18). The oil goes through the passage into the cap and through bearing cage (21). A high level of oil is kept in the bearing cage by a passage. A seal between bearing cage (21) and support (20) keeps the oil in the bearing cage. The oil goes through a passage to the bearings and back to the lower part of the final drive case.

HYDRAULIC CONTROL VALVE FOR THE STEERING CLUTCHES

Pressure oil is sent to the hydraulic control valve by the transmission oil pump. When the control levers are pulled, levers (8) and (22) move plungers (7) to the left. The plungers move the valve spools (6). The movement of the valve spools lets oil go to the steering clutch pistons. The oil pushes against the pistons. The pistons push against the springs and move the pressure plates away from the disc assemblies. This releases the steering clutches.



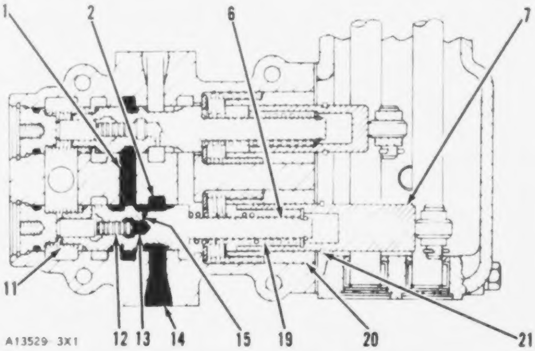
HYDRAULIC CONTROL VALVE FOR STEERING CLUTCHES AND BRAKES

1. Chamber. 2. Chamber. 3. Housing. 4. Chamber. 5. Passage. 6. Valve spools. 7. Plungers. 8. Lever. 9. Tube. 10. Housing. 11. Spring. 12. Slug. 13. Chamber. 14. Passage. 15. Hole. 16. Slot. 17. Washer. 18. Spring. 19. Spring. 20. Bushing. 21. Retainer. 22. Lever.

Flow of Oil

Pressure oil comes through housing (3) and goes in chamber (1). When the steering clutches are engaged, the position of valve spools (6) keeps the oil in chamber (1).

Passages (5) and (14) are connected to oil lines. The oil lines go to the steering clutch pistons. The steering clutches are released by the movement of the control levers. The steering clutches are released when the control levers are pulled until a resistance is felt.

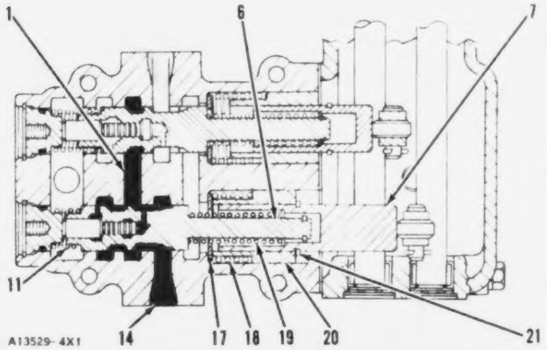


RIGHT STEERING CLUTCH RELEASED

1. Chamber. 2. Chamber. 6. Valve spool. 7. Plunger. 11. Spring. 12. Slug. 13. Chamber. 14. Passage. 15. Hole. 19. Spring. 20. Bushing. 21. Retainer.

When the right control lever is pulled PART WAY, plunger (7) moves against spring (19). The force of spring (19) moves valve spool (6) against spring (11). The movement of valve spool (6) opens chamber (1) to chamber (2). Pressure oil goes from chamber (2) to passage (14). The oil goes from passage (14) and through an oil line to the piston for the right steering clutch. As the pressure behind the steering clutch piston increases, the pressure increase is felt in chamber (13) through hole (15) in the valve spool. The pressure in chamber (13) becomes the same as the pressure behind the steering clutch piston. The pressure in chamber (13) against slug (12) adds with the force of spring (11) and moves valve spool (6) to the right. The movement of valve spool (6) stops the oil to the steering clutch piston. Now the valve spool is in a balance position. The balance position is modulation. The pressure against the steering clutch piston is kept constant. The amount of pressure against the steering clutch piston is a result of the position of plunger (7). The amount of force of spring (19) against valve spool (6) is also a result of the position of plunger (7). The amount of pressure that is needed to release a steering clutch is a result of the load on the machine during operation.

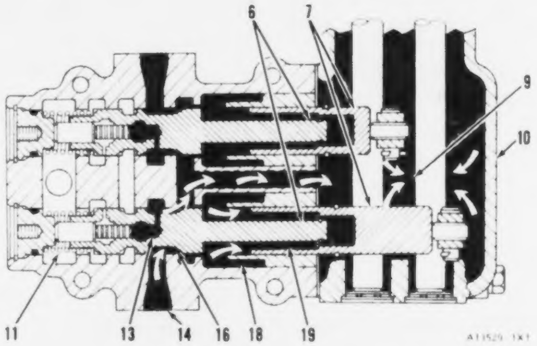
If a control lever is pulled until a resistance is felt, a steering clutch is fully released. There is no modulation of valve spool (6). When a steering clutch is fully released, retainer (21) is against bushing (20). If the control lever is pulled beyond the point of resistance, the steering clutch is still fully released and brake action starts.



RIGHT STEERING CLUTCH FULLY RELEASED AND RIGHT BRAKE FULLY ENGAGED

1. Chamber. 6. Valve spool. 7. Plunger. 11. Spring. 14. Passage. 17. Washer. 18. Spring. 19. Spring. 20. Bushing. 21. Retainer.

When the right control lever is pulled ALL THE WAY, plunger (7) pushes against spring (19). Spring (19) moves valve spool (6) to the left until retainer (21) makes contact with bushing (20). Then plunger (7), spool (6) and bushing (20) move to the left against springs (11), (18) and (19) until bushing (20) makes contact with washer (17). Maximum pressure oil goes from chamber (1) to chamber (2). The oil goes from chamber (2) to passage (14). The oil goes from passage (14) and through an oil line to the piston for the right steering clutch. At this time, maximum pressure oil is against the piston and the steering clutch is fully released. In this position there is no modulation of valve spool (6). At this time, there is also an action of the brakes. See the subject, "BRAKES", in this manual.



RIGHT STEERING CLUTCH ENGAGED

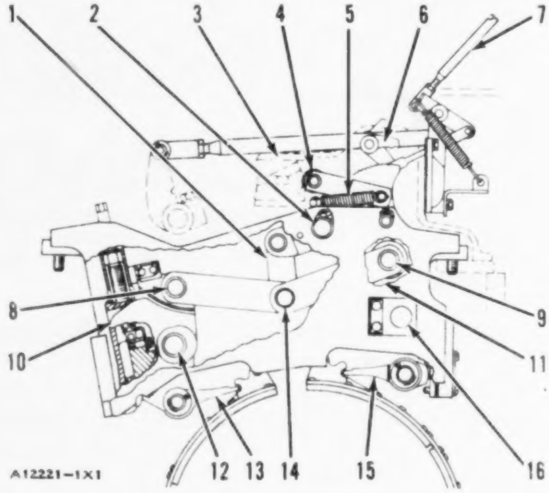
6. Valve spool. 7. Plunger. 9. Tube. 10. Housing. 11. Spring. 13. Chamber. 14. Passage. 16. Slots. 18. Spring. 19. Spring.

When the right control lever is released, the pressure oil in chamber (13) together with the force of springs (11), (18) and (19) moves valve spool (6) and plunger (7) all the way to the right. The oil behind the steering clutch piston comes back through the oil line to passage (14). The oil goes through passage (14) to chamber (2). The oil goes from chamber (2) through slots (16) and an oil passage to housing (10). This oil is for lubrication of the mechanical linkage. The oil level in housing (10) is controlled by tube (9). The extra oil goes from the housing through tube (9). This oil is for lubrication of the bevel gear and pinion and the bevel gear shaft bearings.

BRAKES

Two band-type brakes, one on each steering clutch drum, stop the movement of the machine. The brakes also give assistance to the steering clutches to turn the machine. The operation of each brake gets assistance from a hydraulic control mechanism. The operation of each brake is separate from the other. Either one or both brakes can be held in the "ON" position by pawl (6) on the brake linkage.

The operation of both brakes is the same. When a brake pedal is pushed toward the front of the machine, mechanical linkage moves piston (3) in the hydraulic control mechanism. The piston (3) pushes against the roller on bellcrank (4). The bellcrank turns on the shaft (2) and moves the link (1) toward the top. This moves pin (14) toward the top and pins (8) and (9) away from each other. The levers (10) and (11) then turn on shafts (12) and (16). Levers (10) and (11) move struts (13) and (15) toward each other. As the struts move toward each other, they push on the ends of the brake band. This causes the brake band to make contact with the steering clutch drum. Now, the movement of the machine stops or becomes slower.



BRAKE LINKAGE

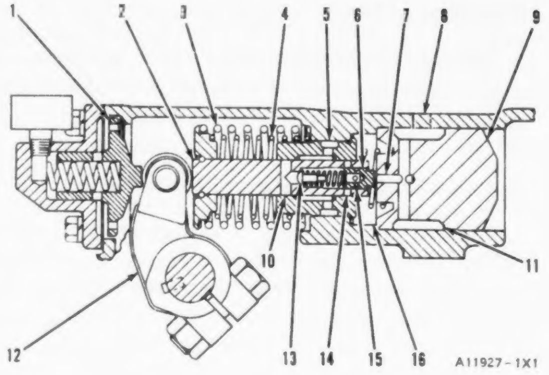
1. Link. 2. Shaft. 3. Piston. 4. Bellcrank. 5. Spring. 6. Pawl. 7. Rod. 8. Pin. 9. Pin. 10. Lever. 11. Lever. 12. Shaft. 13. Strut. 14. Pin. 15. Strut. 16. Shaft.

When the brake pedal is released, spring (5) and springs inside the hydraulic control mechanism move the mechanical linkage and brake pedal. The struts move away from each other. The brake band is not in contact with the steering clutch drum. Now, the brakes are in the "OFF" position.

Either one or both brakes can be held in the "ON" position. Push one or both brake pedals toward the front of the machine. At the same time, push the parking brake lever forward and down. The parking brake lever is at the right side of the seat. The movement of the lever moves rod (7) and engages the teeth of the pawl (6) with the teeth of the ratchet. The brakes are held in the "ON" position by the link. The links push against the bellcrank (4). To release the brakes, push on the brake pedal or pedals and pull the parking brake lever up and backwards.

An oil line sends pressure oil to each brake band. This oil is for lubrication and cooling of the brake bands.

Hydraulic Control Mechanism



HYDRAULIC CONTROL MECHANISM

1. Stop. 2. Plunger. 3. Spring. 4. Spring. 5. Chamber. 6. Valve. 7. Passage. 8. Passage. 9. Piston. 10. Passage. 11. Chamber. 12. Lever. 13. Plunger. 14. Passage. 15. Passage. 16. Chamber.

Pressure oil is sent to each hydraulic control mechanism. On power shift machines, this oil comes from an oil manifold on the control valve for the steering clutches. On direct drive machines this oil comes from a relief valve on the control valve for the steering clutches. The oil goes in the housing and fills chamber (5).

When the brakes are in the "OFF" position, the oil is kept in chamber (5).

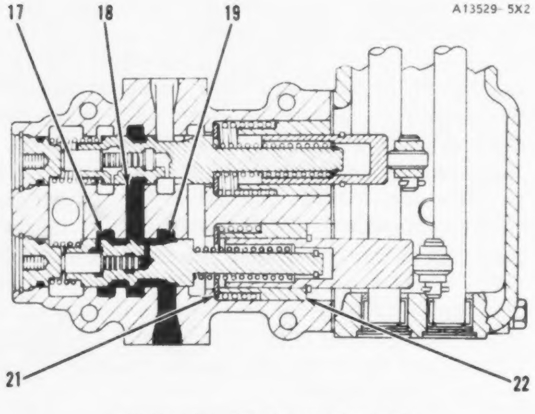
When a brake pedal is pushed forward, lever (12) pushes plunger (2) and valve (6) to the right against piston (9). This closes passage (7) in the piston. The movement of plunger (2) and valve (6) opens passages (10), (14) and (15). The oil goes from chamber (5) through passage (10) and opens plunger (13). The oil goes through plunger (2) to the center of valve (6). The oil goes through holes in valve (6) and out passage (15). The oil goes through passages (15) and (14) and starts to fill the chamber. When the pressure of the oil in chamber (16) increases, piston (9) will move to the right. The piston pushes against the bellcrank of the brake linkage. The bellcrank moves the mechanical linkage and the brake band makes contact with the steering clutch drum.

When a brake pedal is released, lever (12) moves until it is against stop (1). The force of springs (3) and (4) move plunger (2) and valve (6) away from the piston (9). The movement of valve (6) and plunger (2) closes passages (10), (14) and (15) and opens passage (7). The pressure of the oil in chamber (16) decreases. Piston (9) moves away from the bellcrank. The oil that was in chamber (16) goes through passages (7) and (8) to an oil line. The oil goes through the oil line to the control valve for the steering clutches. The oil then goes through a drain tube to the bevel gear case.

Plunger (13) keeps pressure oil in chamber (16) if the pressure in the system decreases for a short period of time when the brakes are "ON".

Common Steering Clutch and Brake Hydraulics

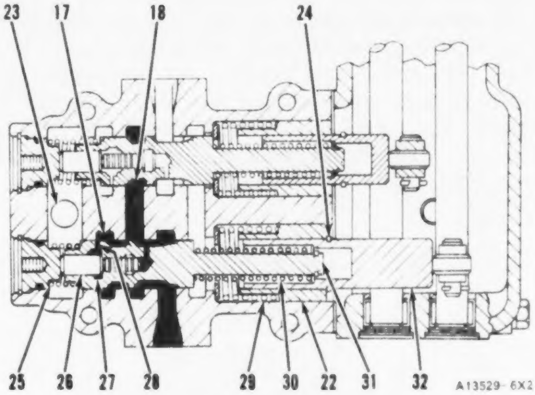
When a control lever for a steering clutch is pulled all the way back, a steering clutch is released. At the same time, pressure oil is sent to a valve which engages a brake. This is done without the use of a brake pedal. In the control valve for the steering clutches, bushing (22) is against washer (21). Pressure oil comes through chamber (18) and goes to chambers (17) and (19). From chamber (19) pressure oil goes to the steering clutch piston and releases a steering clutch. From chamber (17), pressure oil goes through an oil line to passage (8) in the hydraulic control mechanism for the brake. The oil goes through passage (8) to chamber (11) in piston (9). The oil then goes through passage (7) and starts to fill chamber (16). The positions of plunger (2) and valve (6) let the pressure of the oil in chamber (16) increase. As the pressure increases, piston (9) moves to the right against the bellcrank. The piston pushes the bellcrank. The bellcrank moves the mechanical linkage and a brake band makes contact with the steering clutch drum. At this time, the machine makes a turn.



RIGHT BRAKE FULLY ENGAGED

17. Chamber. 18. Chamber. 19. Chamber. 21. Washer. 22. Bushing.

If the operator pulls a clutch control lever PART WAY to release a steering clutch and makes some application of a brake, a resistance is felt in the lever when retainer (24) makes contact with bushing (22). At this time, the action of the brake begins. Spool (31) moves to the left. The resistance in the lever lets the operator know the start of the action of the brake.

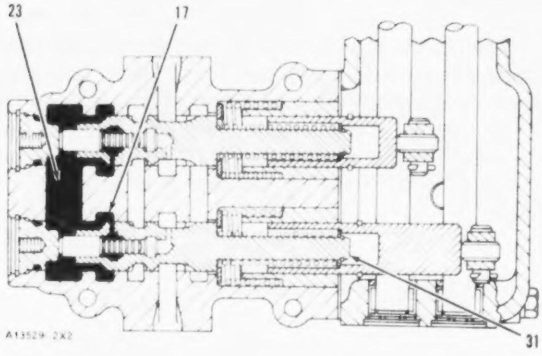


RIGHT BRAKE ENGAGED PART WAY

17. Chamber. 18. Chamber. 22. Bushing. 23. Tube. 24. Retainer. 25. Spring. 26. Slug. 27. Chamber. 28. Hole. 29. Spring. 30. Spring. 31. Valve spool. 32. Plunger.

As spool (31) moves to the left, pressure oil from chamber (18) starts to fill chamber (17). The oil goes from chamber (17) to a line. Oil goes through the line and in passage (8) of the hydraulic control mechanism for the brake. As chamber (16) is filled with pressure oil, piston (9) moves to the right and starts the application of the brake. As the pressure behind piston (9) increases, the pressure increase is felt in chamber (27) through hole (28). The pressure in chamber (27) becomes the same as the pressure behind piston (9). The pressure in chamber (27) against slug (26) adds with the force of springs (29) and (30) and moves spool (31) to right. The oil from chamber (17) to the hydraulic control mechanism for the brake is stopped by valve spool (31). Now valve spool (31) is in a balance position. The balance position is modulation. The pressure against piston (9) is kept constant. The amount of pressure against piston (9) is a result of the position of plunger (32). The amount of force of springs (29) and (30) against valve spool (31) is also a result of the position of plunger (32). The amount of force needed for some application of the brake is controlled by the operator.

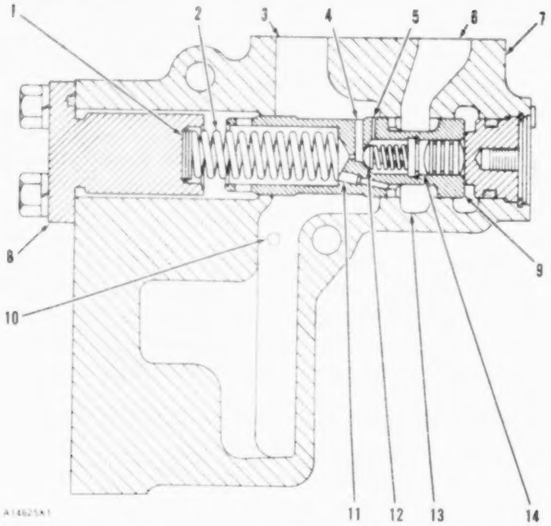
When the control lever for the steering clutch is released, valve spool (31) moves to a neutral position. Oil in chamber (16) goes through a line to chamber (17). Oil then goes from chamber (17) through drain tube (23) to the reservoir in the bevel gear case. At this time, the hydraulic controls are in a neutral position. The steering clutches are engaged and the brakes are released.



RIGHT BRAKE FULLY RELEASED

17. Chamber. 23. Tube. 31. Valve spool.

RELIEF VALVE FOR HYDRAULIC CONTROLS FOR STEERING CLUTCHES AND BRAKES (DIRECT DRIVE)



RELIEF VALVE FOR HYDRAULIC CONTROLS FOR STEERING CLUTCHES AND BRAKES

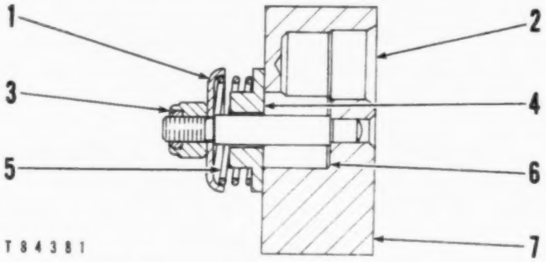
1. Spacers. 2. Spring. 3. Opening. 4. Passage. 5. Orifice. 6. Opening. 7. Valve body. 8. Cover. 9. Valve spool. 10. Passage to hydraulic control valve. 11. Orifice. 12. Plunger. 13. Chamber. 14. Chamber.

The relief valve is on the top of the hydraulic control valve for the steering clutches and brakes. The relief valve controls the pressure of the oil that goes in the hydraulic control valve and the hydrau-mechanisms for the brakes. Extra oil is sent to the oil cooler on the engine.

Oil, from the hydraulic control mechanism for the flywheel clutch, goes in valve body (7) through opening (3). The oil goes through passage (4) and opens plunger (12). Oil fills chamber (14). When the pressure of the oil in chamber (14) goes higher than 415 ± 5 psi (29.2 ± 1.8 kg/cm^2), pressure oil in chamber moves valve spool (9) to the left. The movement of valve spool (9) puts spring (2) in compression. This lets the extra oil go in chamber (13). The oil goes from chamber (13) to opening (6). From opening (6) the extra oil goes to the oil cooler.

When a brake is engaged or a steering clutch is released, the pressure in chamber (14) decreases. The force of spring (2) moves valve spool (9) to the right. The movement of the valve spool stops the flow of oil to chamber (13). At this time oil, does not go through opening (6) to the oil cooler. Oil in chamber (14) goes through orifice (5) and oil in chamber (13) goes through orifice (11). This slows the movement of valve spool (9). Spacers (1) are used to adjust the pressure of the valve. Passages in valve body (7), at each end of valve spool (9), let leakage oil go from the valve body.

RELIEF VALVE FOR BRAKE COOLING AND LUBRICATION



RELIEF VALVE FOR BRAKE COOLING AND LUBRICATION

1. Washer. 2. Oil inlet opening. 3. Nut. 4. Valve. 5. Spring. 6. Chamber. 7. Valve body.

The relief valve for brake cooling and lubrication is in the compartment for the right steering clutch. It lets oil at a specific pressure go to the brake bands. Cool oil goes in the valve through opening (2) and fills chamber (6). On direct drive machines, the oil comes from the oil manifold on the transmission. On power shift machines, the oil comes from the oil pump on the torque divider housing. Chamber (6) has two openings. A hose is connected to each of the openings. One hose goes to the right brake band and the other hose goes to the left brake band. The oil goes from chamber (6) through the two hoses to the brake bands. The oil pressure to the brake bands is controlled by spring (5) and valve (4). When the pressure of the oil in chamber (6) goes above 50 ± 5 psi (3.5 ± 0.4 kg/cm^2), valve (4) moves and lets the extra oil go to the compartment for the right steering clutch.

UNDERCARRIAGE

The undercarriage connects to the body and final drives. Two track assemblies are kept in parallel alignment by the diagonal braces of the track roller frames. Each track assembly can move up and down by itself.

The components of the undercarriage are: equalizer bar, track rollers, track carrier rollers, tracks, front idlers, track roller frames, track adjusters and recoil springs.

The front idlers, track rollers and track carrier rollers use Duo-Cone seals to prevent the loss of lubricant and to keep out foreign material.

TRACK ROLLER FRAMES

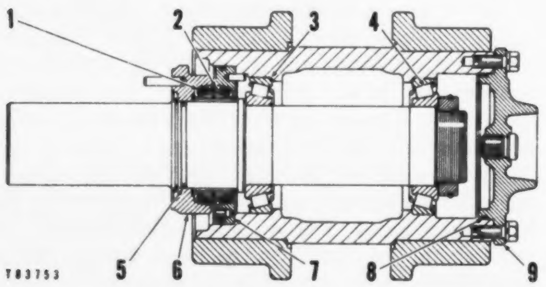
The track roller frames are fastened to the final drive bearing cage and to the steering clutch and bevel gear case. The parallel alignment of the track roller frames is kept by diagonal braces. Each roller frame can move up and down by itself.

The track rollers, track carrier rollers, front idlers, track adjusters and recoil springs are fastened to the track roller frames.

The alignment of the track roller frames and final drives is controlled by the shim adjustment of the final drives.

TRACK CARRIER ROLLERS

The track carrier rollers give support to the track between the sprocket and the front idler. The shaft of the track carrier roller is fastened to a support bracket by a clamp. The support bracket is fastened to the track roller frame.

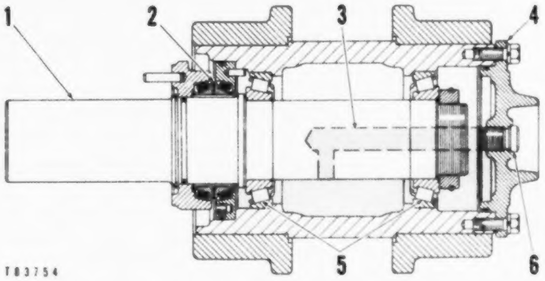


TRACK CARRIER ROLLER

1. Rubber toric seal rings (two). 2. Metal floating ring seals (two). 3. Bearing. 4. Bearing. 5. O-ring seal. 6. End collar. 7. Seal support. 8. O-ring seal. 9. End cover.

The track carrier rollers must be in alignment with the sprocket and the front idler. The alignment is done by the movement of the roller shaft inside the support bracket. The carrier rollers turn on two tapered roller bearings. The adjustment of the bearings is done by the nut on the end of the shaft.

Track Carrier Roller Lubrication



TRACK CARRIER ROLLER

1. Shaft. 2. Duo-Cone seals. 3. Passage. 4. Cover. 5. Bearings. 6. Plug.

If lubricant is added with the roller removed from the machine, shaft (1) must be in a horizontal position.

Lubricant is sent into center passage (3) through the 5M2080 Nozzle. The lubricant fills the cavity between shaft (1) and the roller. When the cavity is full, the pressure of the oil causes the air and extra lubricant to go out the relief threads in the nozzle.

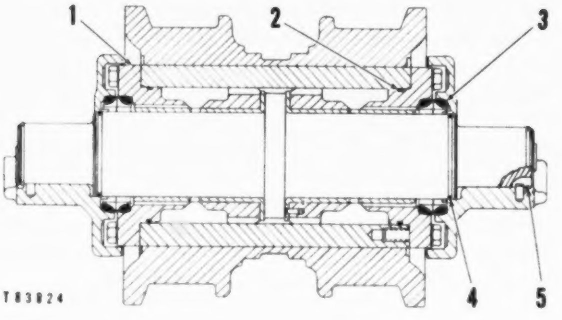
When the lubricant does not have any bubbles, remove the nozzle and install the plug. Tighten the plug to a torque of 125 ± 15 lb.ft. (17.3 ± 2.1 mkg).

TRACK ROLLERS

The track rollers are fastened to the track roller frames. The track rollers are in contact with the inside surfaces of the track links. Flanges on the track rollers prevent the movement of the track from side to side. The inside surfaces of the track links cause an equal distribution of the weight of the machine along the track.

Each track roller frame has seven track rollers, three single flange and four double flange. The installation of the track rollers is as follows: 1. Start at the front of the machine and install two double flange rollers. 2. Then install two single flange rollers. 3. Then install two double flange rollers. 4.

Install one single flange roller next to the final drive sprocket.



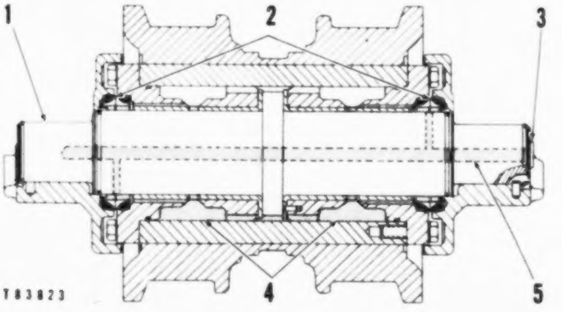
TRACK ROLLER

1. Pin. 2. Inner end collar. 3. Bearings. 4. Outer end collar. 5. Shaft. 6. Duo-Cone seals. 7. Track roller.

The flange at the center of shaft (5) gets the side load on the roller. Bearings (3) also get the side load on the roller. The amount of side movement or end clearance of the shaft can not be adjusted.

The track rollers have Duo-Cone floating seals (6) at both ends of shaft (5).

Track Roller Lubrication



TRACK ROLLER

1. Shaft. 2. Duo-Cone seals. 3. Plug. 4. Reservoirs. 5. Center passage.

If lubricant is added with the roller removed from the machine, shaft (1) must be in a horizontal position. The slot, in the end where the 5M2080 Nozzle is installed, must be down.

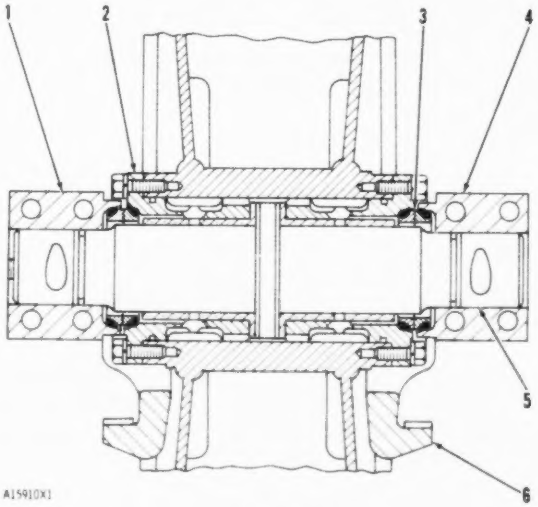
Lubricant is sent into center passage (5) through the 5M2080 Nozzle. The lubricant fills the reservoirs (4) in the rollers. When the reservoirs are full, the pressure of the oil causes the air and extra lubricant to go out the relief threads in the nozzle.

When the lubricant does not have any bubbles, remove the nozzle and install the plug. Tighten the plug to a torque of 125 ± 15 lb.ft. (17.3 ± 2.1 mkg).

FRONT IDLERS

The front idlers put the tracks in position in front of the track rollers. They also keep the tracks in alignment with the sprockets.

The adjustment of the tracks is done by the movement of the front idlers. The track adjusters move the front idlers and hold them in position.



FRONT IDLER

1. Bearing. 2. Bushing assemblies (two). 3. Duo-Cone seals (two). 4. Bearing. 5. Shaft. 6. End collars (two).

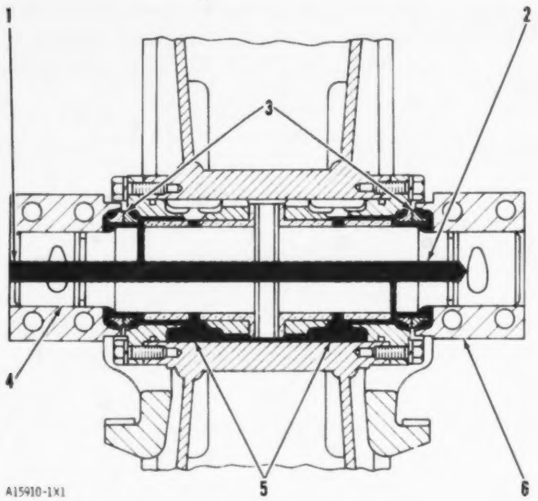
The position of the front idlers is controlled by shims. The front idlers must have correct alignment with the track roller frames.

Front Idler Lubrication

If lubricant is added with the idler removed from the machine, the shaft (4) must be in a horizontal position.

Lubricant is sent through the 5M2080 Nozzle into the center passage (2). The lubricant fills reservoirs (5) around shaft (4). When the reservoirs are full, the pressure of the oil causes the air and extra lubricant to go out the relief threads in the nozzle.

When the lubricant does not have any bubbles, remove the nozzle and install plug (1). Tighten the plug to a torque of 125 ± 15 lb.ft. (17.3 ± 2.1 mkg).

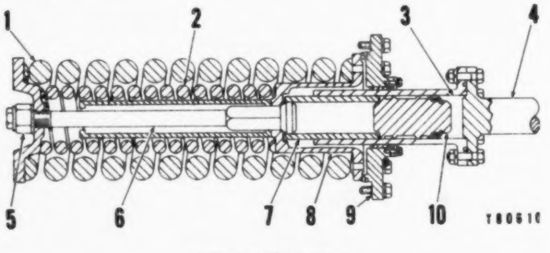


FRONT IDLER

1. Plug. 2. Center passage. 3. Duo-Cone seals. 4. Shaft. 5. Reservoirs. 6. Bearing.

RECOIL SPRINGS AND MECHANISMS FOR TRACK ADJUSTMENT

The recoil springs are normally in compression. They are held between brackets and stops on the track roller frames. Normally, the recoil springs do not push against the track.



RECOIL SPRINGS

1. Spring. 2. Spring. 3. Cavity. 4. Recoil rod. 5. Nut. 6. Bolt. 7. Sleeve. 8. Pilot. 9. Cover. 10. Piston.

Track adjustment is made by the hydraulic mechanism for track adjustment. Pressure grease is sent to cavity (3) through a fill valve. This moves recoil rod (4) and the front idler forward. The movement of the recoil rod and front idler tightens the track. The tension on the track is released by opening a relief valve.

⚠ WARNING: Never visually inspect the vent holes or valves to see if grease or oil is coming out of them. Make sure the vent holes are clean before the tension is released on the track. Watch the cylinder to see that it moves.

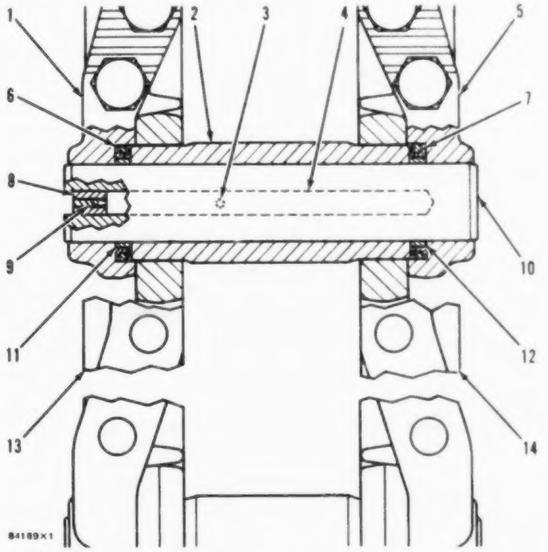
If rocks or other materials get between the track and rollers, idler or sprocket, recoil rod (4) moves to the rear. Since the grease in cavity (3) can not be put in compression, piston (10) and sleeve (7) move to the rear. Sleeve (7) pushes on pilot (8) which puts springs (1) and (2) in compression. This prevents too much tension on the track.

Compression of the recoil springs is limited by sleeve (7) on recoil spring bolt (6). Cover (9) is fastened to the recoil spring housing and holds the springs in compression when the grease pressure is released. Nut (5) is used to keep recoil spring compression if the spring assembly is removed.

TRACK

The machine has Sealed and Lubricated track.

Each track assembly has links, pins, bushings, thrust rings, polyurethane seal assemblies, rubber stoppers and polyurethane plugs.



TRACK ASSEMBLY (SECTION)

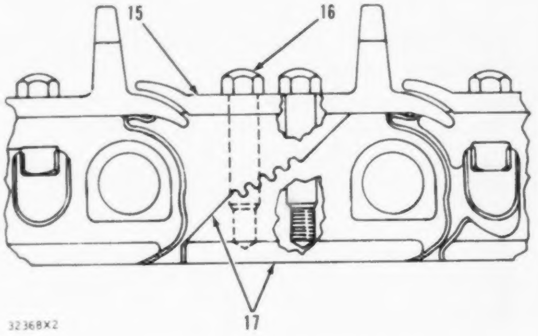
1. Link. 2. Bushing. 3. Hole. 4. Hole. 5. Link. 6. Seal assembly. 7. Seal assembly. 8. Rubber stopper. 9. Polyurethane plug. 10. Pin. 11. Thrust ring. 12. Thrust ring. 13. Link. 14. Link.

Each of the track links (1) and (5) makes a fit over the track links in front of them. Link (1) makes a fit over link (13). Link (5) makes a fit over link (14). The connection of the track links makes the track assembly.

Each link has a counterbore in the end which makes a fit with the link in front of it. Seal assemblies (6) and (7) are installed in the counterbores of the links. Each seal assembly has a load ring and a seal ring. The load ring pushes the seal ring against the end of bushing (2) and the link counterbore. The seal ring gives a positive seal between the bushing and the link counterbore. The edge of the seal ring is against the end of the bushing. The thrust rings (11) and (12) are installed on the pin (10). The thrust rings give a specific amount of compression to the seal assemblies and control the end play (free movement) of the joint. The arrangement of the seal assemblies and thrust rings keeps foreign materials out of the joint and oil in the joint.

The pin (10) has a hole (4) almost the full length of the pin. Hole (3) is drilled radially in the pin near the center of the pin. The radial hole (3) lets oil go to the surface between the pin (10) and the bushing (2) and to the lip of the seal rings. The oil gives lubrication to the pin and bushing and also makes the lip of the seal ring wet. The lip of the seal ring must be kept wet to prevent wear of the lip of the seal ring. Oil is kept in the pin by a stopper (8) and a plug (9). The oil is installed in the pin through a hole in the center of the stopper (8). When the chambers in the pin are filled, the plug (9) is installed in the stopper (8).

The two piece master links (17) and the master shoe (15) are held together with bolts (16).



MASTER LINK AND MASTER SHOE

15. Master shoe. 16. Bolts. 17. Master link.

Each pin and bushing assembly is sealed and has its own lubrication, the result is no internal wear on the joint. The interval for the turning of the track pins and bushings is much longer because the only wear will be on the outside of the bushings and the links.

TROUBLESHOOTING
(POWER SHIFT)

Use this as a reference for the location and correction of problems in the power train. When more checks are necessary, use the 7S8875 or 8M2736 Hydraulic Test Box. Locations of the pressure taps and procedures for testing and adjusting are given in the D8 POWER SHIFT TRANSMISSION TESTING AND ADJUSTING, Form No. SENR7006.

Always make visual checks first. Then check the operation of the machine and go on to check with the instruments.

VISUAL CHECKS

1. Check the oil levels of the transmission and the steering clutch and bevel gear case.
2. Check the oil level in the final drives.
3. Check all oil lines, hoses and connections for leaks and damage. Look for oil on the ground under the machine.
4. Check the control linkages for the transmission, steering clutches and brakes for damage and/or adjustment.
5. Check the adjustment of the track.
6. Let the oil out of the filter housing. Remove and check the filter element for foreign materials. Check the magnetic strainer and the screen in the bottom of the torque divider case.
   a. Bronze-colored particles give an indication of a clutch failure.
   b. Shiny steel particles give the indication of a pump failure.
   c. Rubber particles give an indication of a seal failure or hose failure.
   d. Aluminum particles give an indication of a torque converter failure.

If you find metal or rubber particles, all components of the transmission hydraulic system must be washed clean. Do not use parts with damage. Use new parts.

CHECKS DURING OPERATION

With the engine running, move the selection lever to all speed positions. The detents must be felt in all positions.

Operate the machine in each direction and in all speeds. Make note of all noises that are not normal and find their sources. If the operation is not correct, make reference to the CHECK LIST DURING OPERATION for "problems" and "probable causes".

CHECK LIST DURING OPERATION

Transmission

PROBLEM: Transmission does not operate in any speed or does not engage (slips) in all speeds.

PROBABLE CAUSE:

1. Low oil pressure caused by:
   a. Low oil level.
   b. Control linkage loose or adjustment not correct.
   c. Failure of the oil pump or the pump drive.
   d. Air leaks on inlet side of pump.
   e. Priority valve adjustment not correct.
   f. Leakage inside the transmission.
   g. Adjustment of the modulation relief valve not correct, or valve does not close.
   h. Load piston or differential and safety valve not closing.
2. Mechanical failure in transmission.
3. Failure of torque converter.
4. Bevel pinion and/or bevel gear failure.
5. Failure in steering clutches.
6. Failure in final drives.

PROBLEM: Transmission does not make a shift.

PROBABLE CAUSE:

1. Control linkage loose or adjustment not correct.
2. Low oil level.
3. Low clutch pressures.

PROBLEM: Slow shifts.

PROBABLE CAUSE:

1. Low oil pressure.
2. Adjustment of control linkage not correct.
3. Air leaks on inlet side of pump.
4. Load piston or differential and safety valve not moving.

PROBLEM: **Transmission engages very suddenly (rough shifting).**

PROBABLE CAUSE:

1. Initial setting of the modulation relief valve not correct.
2. Adjustment of control linkage not correct.
3. Load piston or differential and safety valve not moving.
4. Valve springs that are weak or have damage.

PROBLEM: **Transmission operates in FORWARD speeds only.**

PROBABLE CAUSE:

1. Control linkage loose or adjustment not correct.
2. No. 2 clutch not engaged (slips) because of:
   a. Low oil pressure.
   b. Discs and plates have too much wear.

PROBLEM: **Transmission operates in REVERSE speeds only.**

PROBABLE CAUSE:

1. Control linkage loose or adjustment not correct.
2. No. 1 clutch not engaged (slips) because of:
   a. Low oil pressure.
   b. Discs and plates have too much wear.

PROBLEM: **Transmission does not operate in FIRST speed FORWARD or REVERSE.**

PROBABLE CAUSE:

1. No. 5 clutch not engaged (slips) because of:
   a. Low oil pressure.
   b. Discs and plates have too much wear.

PROBLEM: **Transmission does not operate in SECOND speed FORWARD or REVERSE.**

PROBABLE CAUSE:

1. No. 3 clutch not engaged (slips) because of:
   a. Low oil pressure.
   b. Discs and plates have too much wear.

PROBLEM: **Transmission does not operate in THIRD speed FORWARD or REVERSE.**

PROBABLE CAUSE:

1. No. 4 clutch not engaged (slips) because of:
   a. Low oil pressure.
   b. Discs and plates have too much wear.

PROBLEM: **Transmission is in a speed, when the selection lever is in NEUTRAL.**

PROBABLE CAUSE:

1. Control linkage loose or adjustment not correct.
2. Direction clutch is engaged.

PROBLEM: **Transmission engages but the machine does not move and the engine stops.**

PROBABLE CAUSE:

1. Failure in final drives.
2. Failure in steering clutches.
3. Failure in bevel gear and pinion.
4. Gears in the transmission will not move because of:
   a. Too many clutches are engaged.
   b. Mechanical failure in transmission.

PROBLEM: **Transmission gets hot.**

PROBABLE CAUSE:

1. Low oil level.
2. High oil level.
3. Core of oil cooler not completely open.
4. Low oil flow as a result of pump wear.
5. Long periods of operation with converter at or near stall speed.
6. Too much resistance between the plates and discs of the clutches when not engaged.

PROBLEM: **Pump noise not normal.**

PROBABLE CAUSE:

1. Loud sounds at short intervals that give an indication that particles are going through the pump are caused by pump cavitation.
2. A constant loud noise is an indication of pump failure.
3. Air at the inlet side of the pump (aeration).

Torque Converter

PROBLEM: **Torque converter gets hot.**

PROBABLE CAUSE:

1. Bad temperature gauge.
2. Mechanical failure in torque converter.
3. Core of oil cooler not completely open.
4. Long periods of operation with converter at or near stall speed.
5. Too much oil leakage in torque converter. (Oil fills the torque divider housing.)
6. Too much restriction in oil cooler lines.

7. Not enough oil to torque converter because of:
   a. Oil pump failure.
   b. Too much oil leakage in transmission.
   c. Inlet relief valve not operating correctly.

Torque Divider

The information that follows must be used to diagnose troubles in the torque divider. This information does not give every possible trouble, however, many of the common troubles are given.

PROBLEM: Torque divider gets hot.

PROBABLE CAUSE:

1. Air in oil system.
   a. Vents for system not open.
   b. Loose oil line connections.
   c. Loose oil filter cover.
2. Low oil pressure.
   a. Leakage around torque converter seals.
   b. Oil line between inlet relief valve and torque converter has restrictions.
   c. Inlet relief valve not closing.
   d. Outlet relief valve not closing.
   e. Low oil level.
   f. Bad scavenge pump.
3. Defects in cooling system.
   a. Low coolant level.
   b. Loose fan belts.
   c. Bad water pump.
   d. Oil cooler core not open.
   e. Restrictions in oil cooler lines.
4. Operation in high altitudes.
5. Operation in high outside temperatures.
6. Long periods of operation with the torque converter at or near stall speed.
7. Bad temperature gauge.
8. Transmission not in the correct speed for the load on the machine.

PROBLEM: Loss of oil.

PROBABLE CAUSE:

1. Connections.
   a. Tubes.
   b. Hoses.
2. Scavenge pump.
   a. Leakage around cover gasket.
3. Seals.
   a. Impeller to carrier seals.
   b. Front bearing retainer to carrier seals.
   c. Oil seal for torque divider output shaft.
4. Gaskets.
   a. Flywheel housing to torque divider housing.
   b. Seal and bearing carriers.

PROBLEM: High inlet pressure.

PROBABLE CAUSE:

1. Inlet relief valve will not open.
2. Restrictions in outlet relief valve.
3. Spring in outlet relief valve too strong.
4. Restrictions in outlet line to oil cooler.

PROBLEM: Low inlet pressure.

PROBABLE CAUSE:

1. Bad transmission or scavenge pump.
2. Not enough inlet oil.
3. Inlet relief valve.
   a. Dirt or foreign material will not let valve close.
4. Outlet relief valve.
   a. Spring too weak.
   b. Dirt or foreign material will not let valve close.
5. Seal leakage.
   a. Impeller to carrier seals.
   b. Front bearing retainer to carrier seals.

PROBLEM: Noises in torque converter that sound like metal in contact.

PROBABLE CAUSE:

1. Bearings that have too much wear or damage.
2. Loose turbine, impeller or stator blades.
3. Too much side load on output shaft.

PROBLEM: Too much oil in torque divider housing.

PROBABLE CAUSE:

1. Bad scavenge pump.
2. Inlet screen for scavenge pump not open.
3. Too much leakage inside the torque converter.

PROBLEM: Noise in planetary gears of torque divider.

PROBABLE CAUSE:

1. Failure of bearings for planetary gears.
2. Failure of gear teeth.
3. Failure of bearing in flywheel.

NOTE: Check for leakage in the torque divider when the oil is at the normal temperature of operation.

Steering

PROBLEM: Machine will not turn in one direction.

PROBABLE CAUSE:

1. Adjustment of steering control linkage not correct.

2. Too much leakage in steering clutch control valve.
3. Steering clutch discs or plates have wear or damage.
4. Seals of steering clutch piston have damage.

PROBLEM: Machine will not turn in either direction.

PROBABLE CAUSE:

1. Low oil pressure to steering clutch control valve.
2. Leaks in control valve.
3. Adjustments of control linkages for the steering clutches and brakes not correct.
4. Steering clutch or clutches not releasing.

PROBLEM: Machine moves in either direction when both steering clutches are engaged.

PROBABLE CAUSE:

1. Adjustments of the control linkages for the steering clutches and brakes not correct.
2. Steering clutch discs or plates have wear or damage.
3. Steering clutch springs that are weak or have damage.
4. Bolts that hold the steering clutch springs are broken.
5. Splines on the steering clutch hubs have damage.
6. Weak or broken springs in control valve.

PROBLEM: Slow steering.

PROBABLE CAUSE:

1. Control linkages for the steering clutches and brakes loose or adjustment not correct.
2. Brake linings have wear or damage.
3. Low oil pressure to steering clutch control valve.
4. Splines on steering clutch hubs have damage.
5. Leaks in steering clutch control valve.

TROUBLESHOOTING

(DIRECT DRIVE)

Use this as a reference for the location and correction of problems in the power train. When more checks are necessary, use the 7S8875 or 8M2736 Hydraulic Test Box. Locations of the pressure taps and procedures for testing and adjusting are given in the HYDRAULIC SYSTEM (Direct Drive) TESTING AND ADJUSTING in this manual.

Always make visual checks first. Then check the operation of the machine and go on to check with the instruments.

VISUAL CHECKS

1. Check the oil levels of the flywheel clutch, transmission and bevel gear case.
2. Check the oil levels of the final drives.
3. Check all oil lines, hoses and connections for leaks or damage. Look for oil on the ground under the machine.
4. Check the control linkages for the flywheel clutch, transmission, steering clutches and brakes for damage and/or adjustment.
5. With the flywheel clutch not engaged, turn the universal joint by hand. It must turn freely. If the oil is cold, the universal joint will be harder to turn. If the universal joint does not turn, disconnect it from the flywheel clutch. Turn the universal joint again and see if the gears in the transmission turn.
6. Check the magnetic strainer, oil filter and scavenge pump screen for foreign material.

If you find metal or rubber particles, all components of the transmission hydraulic system must be washed clean. Do not use parts with damage. Use new parts.

CHECKS DURING OPERATION

With the engine running, move the control levers for the transmission to all speed positions and the control lever for the flywheel clutch to all positions.

Operate the machine in each direction and in all speeds. Make note of all noises that are not normal and find their sources. If the operation is not correct, make reference to the CHECK LIST DURING OPERATION for "problems" and "probable causes"

CHECK LIST DURING OPERATION

Transmission

PROBLEM: Transmission does not operate in any speed or is not engaged (slips) in all speeds.

PROBABLE CAUSE:

1. Failure in flywheel clutch.
2. Mechanical failure in transmission.
3. Failure of bevel gear.
4. Failure in steering clutches.

PROBLEM: Transmission operates in REVERSE speeds only or FORWARD speeds only.

PROBABLE CAUSE:

1. Control linkage loose or adjustment not correct.
2. Mechanical failure in transmission.

PROBLEM: Transmission does not make a shift.

PROBABLE CAUSE:

1. Control linkage loose or adjustment not correct.
2. Mechanical failure in transmission.

PROBLEM: Transmission does not remain in a speed when under load conditions.

PROBABLE CAUSE:

1. Interlock linkage adjustment not correct.
2. Interlock linkage has damage.
3. Interlock linkage spring is broken.
4. Ends of interlock plungers and/or notches in shift shafts have wear.
5. Interlock springs are weak or have damage.

PROBLEM: Shifts of the transmission are not easy.

PROBABLE CAUSE:

1. Shift forks have damage or wear.

PROBLEM: Gears in the transmission do not turn.

PROBABLE CAUSE:

1. Failure of the bearings on one or more of the shafts.
2. Gear in transmission is broken.
3. One or more of the gears not correctly engaged (transmission in two speeds at the same time).

PROBLEM: Transmission is in a speed when the control lever is in NEUTRAL.

PROBABLE CAUSE:

1. Control linkage loose or adjustment not correct.
2. Mechanical failure in transmission.

PROBLEM: Transmission gets hot.

PROBABLE CAUSE:

1. High oil level.
2. Low oil flow because of a pump that has wear or leaks in the lubrication system.
3. Low oil level.

PROBLEM: Pump noise not normal.

PROBABLE CAUSE:

1. Loud sounds at short intervals that give an indication that particles are going through the pump are caused by pump cavitation.
2. A constant loud noise is an indication of pump failure.
3. Air at the inlet side of the pump (aeration).

Steering

PROBLEM: Machine will not turn in one direction.

PROBABLE CAUSE:

1. Adjustment of steering control linkage not correct.
2. Too much leakage in steering clutch control valve.
3. Steering clutch discs or plates have wear or damage.
4. Seals of steering clutch piston have damage.

PROBLEM: Machine will not turn in either direction.

PROBABLE CAUSE:

1. Low oil pressure to steering clutch control valve.
2. Adjustment of the relief valve not correct.
3. Leaks in relief valve or control valve.
4. Adjustments of control linkages for the steering clutches and brakes not correct.
5. Steering clutch or clutches not releasing.

PROBLEM: Machine moves in either direction when both steering clutches are engaged.

PROBABLE CAUSE:

1. Adjustments of the control linkages for the steering clutches and brakes not correct.
2. Steering clutch discs or plates have wear or damage.
3. Steering clutch springs that are weak or have damage.
4. Bolts that hold the steering clutch springs are broken.
5. Splines on the steering clutch hubs have damage.

PROBLEM: Slow steering.

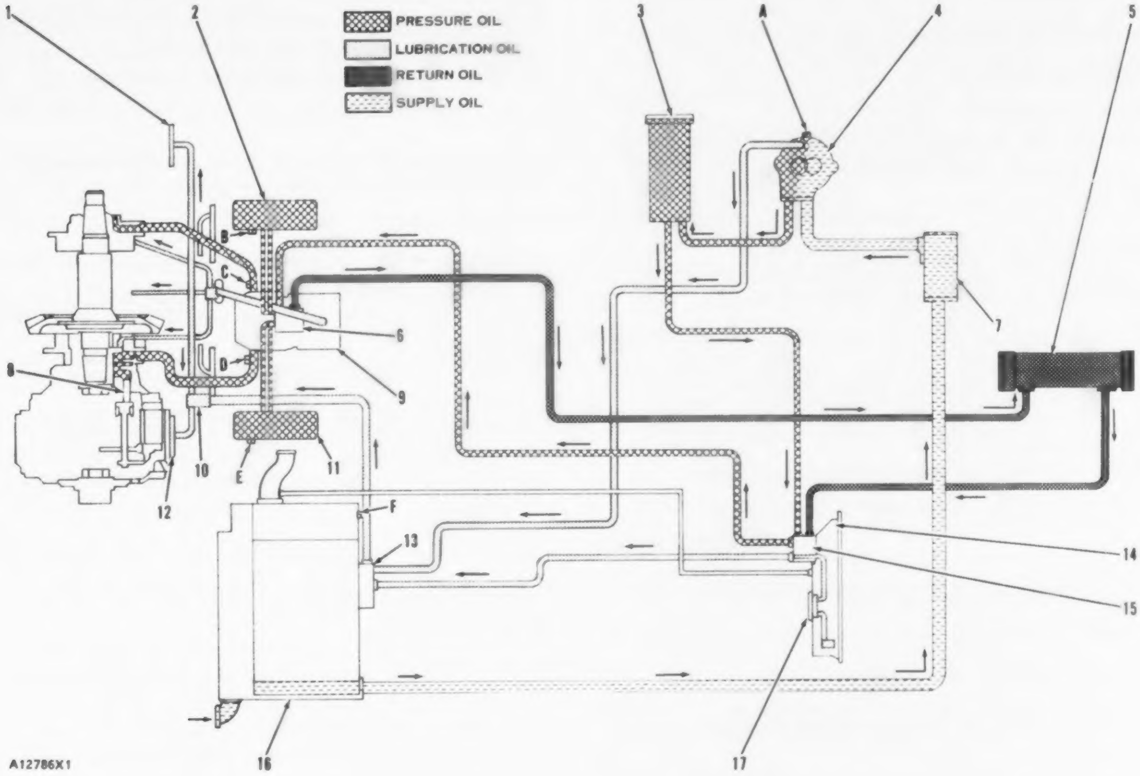
PROBABLE CAUSE:

1. Control linkages for the steering clutches and brakes loose or adjustment not correct.
2. Brake linings have wear or damage.
3. Low oil pressure to steering clutch control valve.
4. Splines on steering clutch hubs have damage.
5. Leaks in steering clutch control valve.

HYDRAULIC SYSTEM

(DIRECT DRIVE)

The hydraulic system has a common oil supply which has one hydraulic oil pump. The tests can be done with the use of pressure gauges or the 7S8875 Hydraulic Test Box.

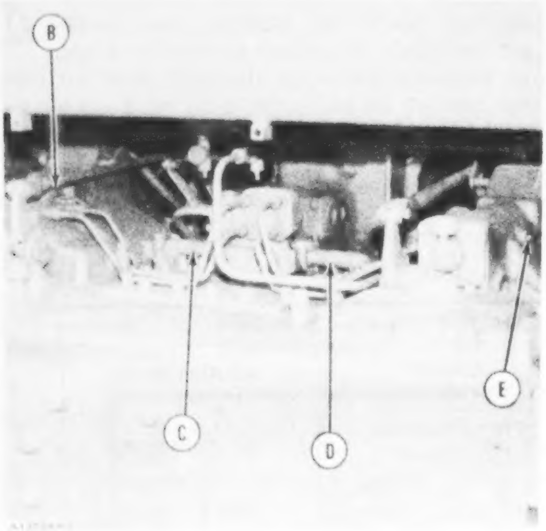


SCHEMATIC OF THE HYDRAULIC SYSTEM

1. Left brake band. 2. Hydraulic control mechanism for the left brake. 3. Oil filter. 4. Transmission oil pump. 5. Oil cooler. 6. Relief valve for the hydraulic controls for the steering clutches and brakes. 7. Magnetic strainer. 8. Steering clutch piston. 9. Hydraulic control valve for the steering clutches. 10. Relief valve for brake cooling and lubrication. 11. Hydraulic control mechanism for the right brake. 12. Right brake band. 13. Oil manifold for transmission lubrication. 14. Flywheel clutch. 15. Hydraulic control mechanism for the flywheel clutch. 16. Transmission case. 17. Oil pump. A. Pressure tap for transmission oil pump. B. Pressure tap for hydraulic control mechanism for left brake. C. Pressure tap for left steering clutch. D. Pressure tap for right steering clutch. E. Pressure tap for hydraulic control mechanism for right brake. F. Pressure tap for transmission lubrication.

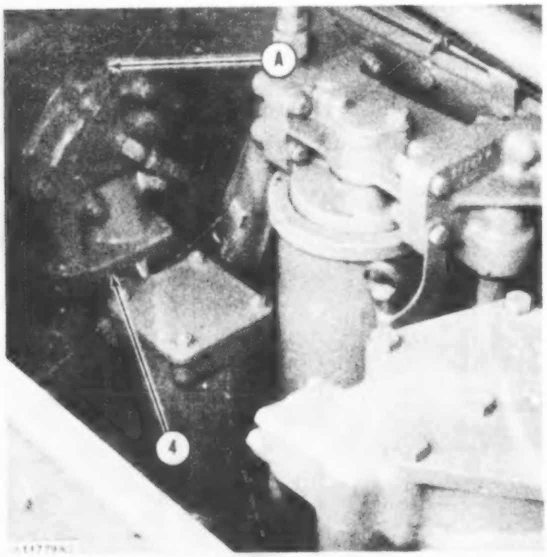
NOTE: All test and adjustments must be made with the oil in the hydraulic system at normal temperature of operation. The high and low idle engine speeds for this machine are given in the RACK SETTING CHARTS.

NOTE: All pressure taps use 1/8"–27 NPT plugs except tap (F) on the transmission front cover. Use a 3B6768 Reducing Bushing when connections are made with pressure tap (F).



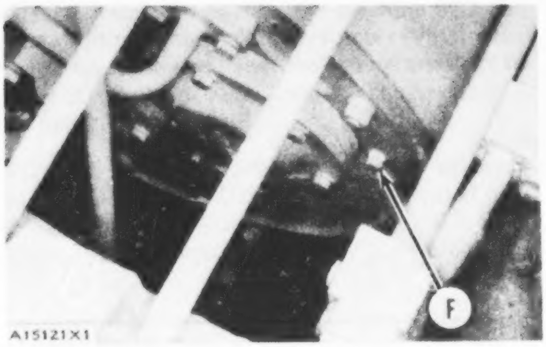
PRESSURE TAPS FOR STEERING CLUTCHES AND BRAKES
(Seen from rear of machine)

B. Pressure tap for hydraulic control mechanism for left brake. C. Pressure tap for left steering clutch. D. Pressure tap for right steering clutch. E. Pressure tap for hydraulic control mechanism for right brake.



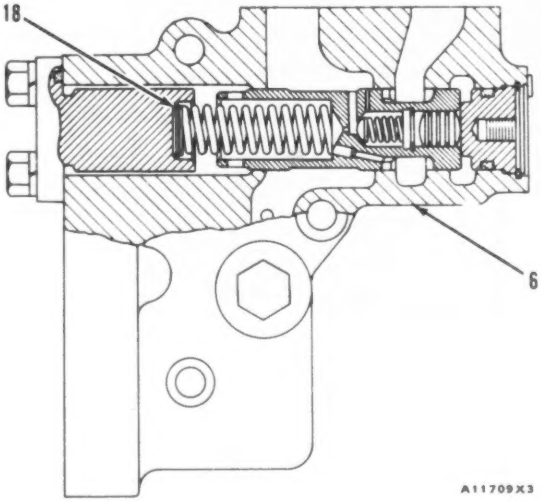
PRESSURE TAP FOR TRANSMISSION OIL PUMP

4. Transmission oil pump. A. Pressure tap for transmission oil pump.



PRESSURE TAP FOR TRANSMISSION LUBRICATION

F. Pressure tap for transmission lubrication.



RELIEF VALVE FOR HYDRAULIC CONTROLS FOR STEERING CLUTCHES AND BRAKES

6. Relief valve. 18. Spacers.

Spacers (18) can be added or removed as necessary to get the correct pressure at tap (A). See the SPACER CHART.

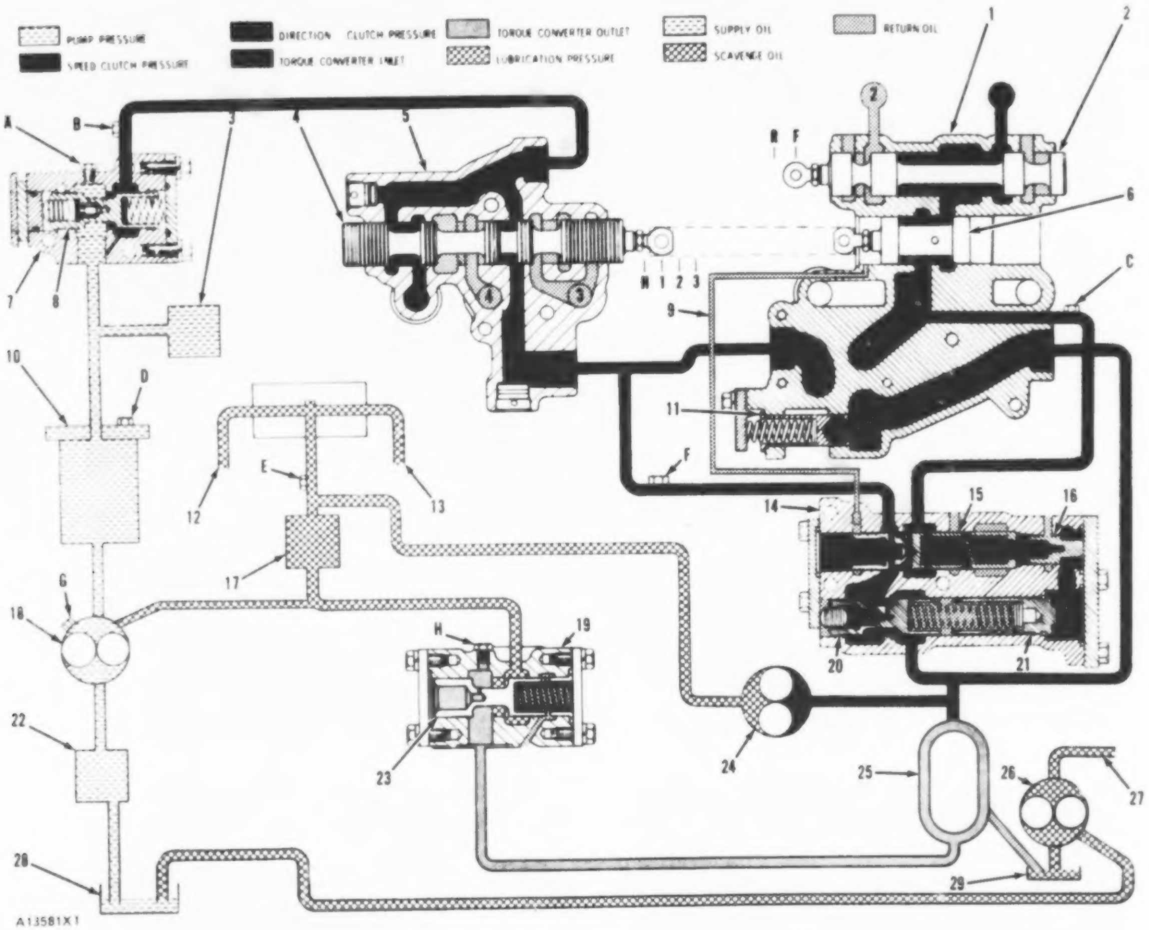
Spacer	SPACER CHART			
	Thickness		Change in Pressure	
	in.	mm	psi	kg/cm^2
5M3492	.010	0.25	4.3	0.3
7M1397	.036	0.91	15.4	1.1

PRESSURE CHART FOR HYDRAULIC SYSTEM			
PRESSURE	**LOCATION**	**VALUE**	**ADJUSTMENT**
Steering clutch pistons (steering clutches released and engine at low idle).	C and D	275 psi minimum (19.3 kg/cm^2)	No adjustment.
Transmission oil pump (steering clutches released and engine at low idle).	A	345 psi minimum (24.3 kg/cm^2)	Add or remove spacers (18) as necessary to relief valve (6).
Relief valve (6) (bench test).		415 ± 5 psi (29.2 ± 1.8 kg/cm^2)	Add or remove spacers (18). See SPACER CHART.
Hydraulic mechanisms for brakes (brakes engaged and engine at high idle).	B and E	390 ± 25 psi (27.4 ± 1.8 kg/cm^2)	No adjustment.
Transmission lubrication oil.	F	50 ± 5 psi (3.5 ± 0.4 kg/cm^2)	No adjustment.

⚠ WARNING: When tests must be done in a closed area, activate the brakes and use blocks to prevent the machine from moving during the tests. Let only approved personnel on the machine. Keep other personnel off the machine and in view of the operator.

CAUTION: Do not operate the machine with the universal joint removed. The force of hydraulic pressure on the output shaft will cause the shaft to move out of the torque divider. The result is a rapid loss of hydraulic oil.

NOTE: All tests and adjustments must be made with the oil in the hydraulic control system at normal temperature of operation. Be sure the linkage adjustments are correct before any tests are made.


PUMP PRESSURE
SPEED CLUTCH PRESSURE
DIRECTION CLUTCH PRESSURE
TORQUE CONVERTER INLET
TORQUE CONVERTER OUTLET
LUBRICATION PRESSURE
SUPPLY OIL
SCAVENGE OIL
RETURN OIL
A
B
3
4
5
1
2
R F
6
7
8
N 1 2 3
C
9
10
D
11
F
12
E
13
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16
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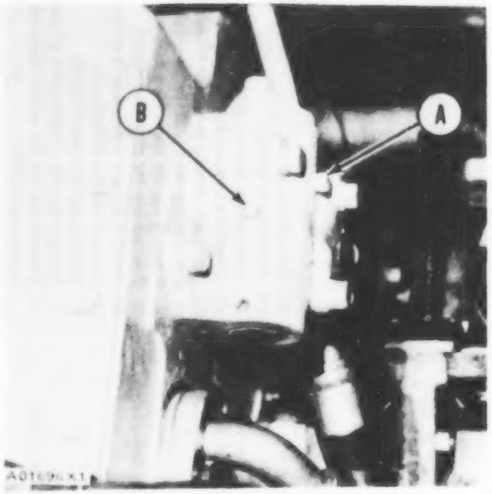
A13581X1

HYDRAULIC CONTROLS (FIRST SPEED FORWARD)

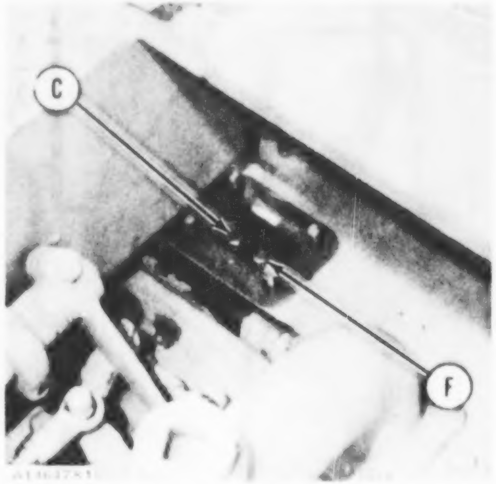
1. Body of safety and direction valve.
2. Direction selection valve.
3. Hydraulic controls for steering clutches.
4. Speed selection valve.
5. Housing for speed selection valve.
6. Safety selection valve.
7. Body of priority valve.
8. Priority valve.
9. Line to safety selection valve.
10. Oil filter.
11. Relief valve for converter inlet.
12. Lubrication line to rear of transmission.
13. Lubrication line to front of transmission.
14. Body of pressure control valve.
15. Pressure differential and safety valve.
16. Check valve.
17. Oil cooler.
18. Transmission oil pump.
19. Body of relief valve for converter outlet.
20. Modulation relief valve.
21. Load piston.
22. Magnetic strainer.
23. Relief valve for converter outlet.
24. Recirculating oil pump.
25. Torque converter.
26. Scavenge oil pump.
27. Lubrication line for brake cooling.
28. Reservoir in transmission case.
29. Reservoir in torque divider housing.

A. Pressure tap for transmission oil pump.
B. Pressure tap for speed clutch.
C. Pressure tap for direction clutch.
D. Pressure tap for transmission oil pump.
E. Pressure tap for lubrication.
F. Pressure tap for speed clutch.
G. Pressure tap for transmission oil pump.
H. Pressure tap for the outlet from the torque converter.

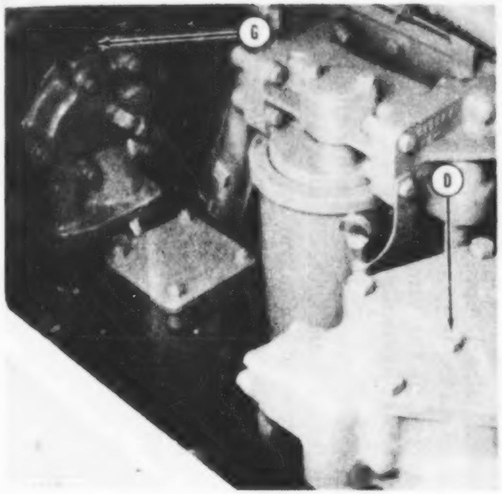
LOCATION OF THE PRESSURE TAPS



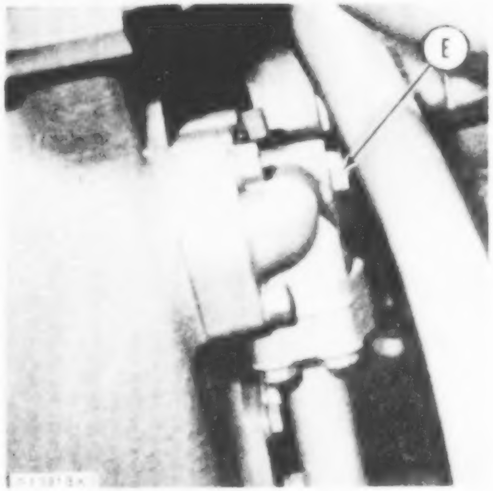
A. Transmission oil pump. B. Speed clutch.



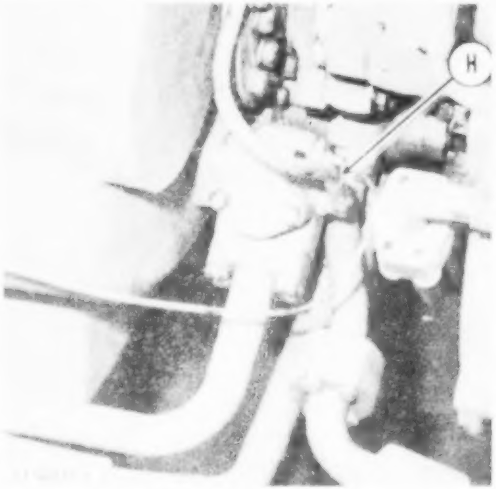
C. Direction clutch. F. Speed clutch.



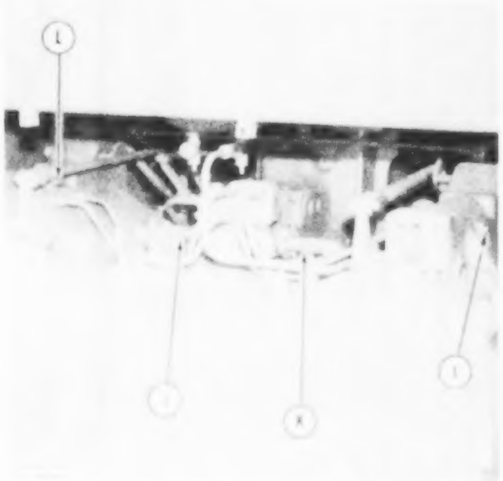
D. and G. Transmission oil pump.



E. Lubrication.

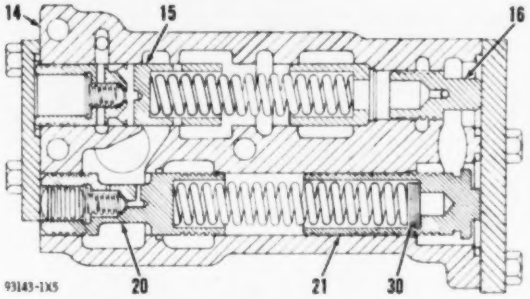


H. Converter outlet.



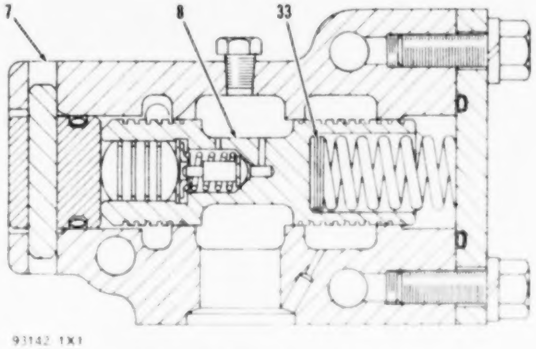
I. Right brake booster. J. Left steering clutch. K. Right steering clutch. L. Left brake booster.

PRESSURE	PRESSURE TAP LOCATION	GOVERNOR CONTROL LEVER AT:		
		MINIMUM SETTING	MAXIMUM SETTING	ADJUSTMENT
Pump	(A), (D) or (G)	365 psi (25.7 kg/cm^2) minimum. Selection lever in NEUTRAL.	415 ± 10 psi (29.2 ± 0.7 kg/cm^2). Selection lever in NEUTRAL.	Add or remove spacers (33) behind priority valve (8). See SPACER CHART.
Speed Clutch	(B) or (F)	300 psi (21.1 kg/cm^2) minimum. Selection lever in NEUTRAL.	345 ± 10 psi (24.3 ± 0.7 kg/cm^2). Selection lever in NEUTRAL.	Add or remove spacers (30) between load piston (21) and modulation relief valve (20). See SPACER CHART.
Direction Clutch (Initial Setting)	(C)	30 psi (2.1 kg/cm^2) Minimum with check valve (10) held open. Selection lever in NEUTRAL.		NONE. Adjustment is controlled by the modulation relief valve.
Direction Clutch	(C)	55 ± 8 psi (3.9 ± 0.6 kg/cm^2) less than the pressure of the speed clutch. Selection lever in NEUTRAL.	55 ± 8 psi (3.9 ± 0.6 kg/cm^2) less than the pressure of the speed clutch. Selection lever in NEUTRAL.	NONE.
Transmission Lubrication Oil	(E)	.5 to 5 psi (0.04 to 0.4 kg/cm^2). Selection lever in NEUTRAL.	11 ± 3 psi (0.8 ± 0.2 kg/cm^2). Selector lever in NEUTRAL.	NONE.
Torque Converter Outlet	(H)		42 ± 5 psi (3.0 ± 0.4 kg/cm^2) with selection lever in THIRD SPEED, brakes activated and converter in a stall.	Add or remove spacers (31) behind relief valve for converter outlet (23). See SPACER CHART.
Torque Converter Inlet: **BENCH TEST** for correct operation			115 ± 6 psi (8.1 ± 0.4 kg/cm^2)	Close the outlet to the converter. Send 4 to 6 U.S. gpm (15.1 to 22.7 lit/min) through the inlet opening. Add or remove spacers (32) to keep 118 ± 3 psi (8.3 ± 0.2 kg/cm^2) while sending the 4 to 6 U.S. gpm (15.1 to 22.7 lit/min) to the reservoir.
TESTS FOR STEERING CLUTCH AND BRAKE CONTROLS				
Brake Boosters	(I) or (L)		390 ± 25 psi (27.4 ± 1.8 kg/cm^2). Selection lever in NEUTRAL and brakes activated.	NONE.
Piston for the Steering Clutch	(J) or (K)	265 psi (18.6 kg/cm^2) with steering clutches released.	410 psi (28.8 kg/cm^2) with steering clutches released.	NONE.



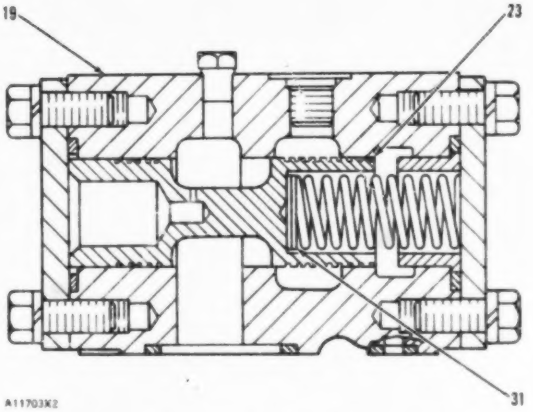
1P4145 PRESSURE CONTROL VALVE

14. Body of pressure control valve. 15. Pressure differential and safety valve. 16. Check valve. 20. Modulation relief valve. 21. Load piston. 30. Spacers.



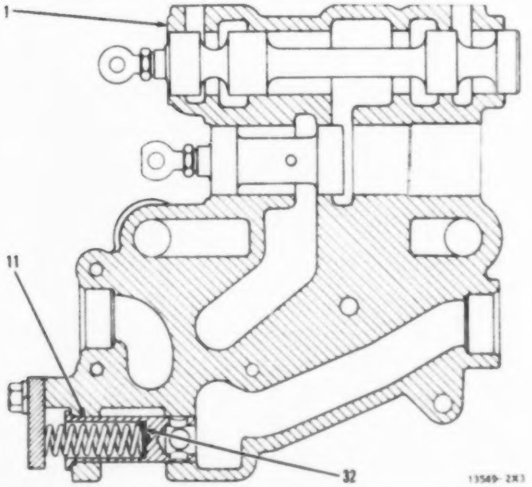
6P3554 PRIORITY VALVE

7. Body of priority valve. 8. Priority valve. 33. Spacers.



3P7665 RELIEF VALVE FOR CONVERTER OUTLET

19. Body of relief valve for converter outlet. 23. Relief valve for converter outlet. 31. Spacers.



1P4107 SAFETY AND DIRECTION VALVE

1. Body of safety and direction valve. 11. Relief valve for converter inlet. 32. Spacers.

PRESSURE CHANGE TO THE VALVES BY REMOVAL OR ADDITION OF ONE SPACER

Spacer Part No.	Thickness		Change In		Where Used
	in.	mm	psi	kg/cm²	
(30) 5M9622 5M9623 5M9624	 .062 .036 .010	 1.57 0.91 0.25	 15.6 9.1 2.5	 1.10 0.64 0.18	Load Piston (21)
(31) 4B5270	 .083	 2.11	 2.7	 0.19	Relief Valve (23) for Converter Outlet
(32) 7M1397 5M3492	 .036 .010	 0.91 0.25	 9.0 2.5	 0.63 0.18	Relief Valve (11) for Converter Inlet
(33) 5M9624	 .010	 0.25	 11.2	 0.79	Priority Valve (8)

7S7400 SCAVENGE AND CIRCULATING OIL PUMP BENCH TEST SPECIFICATIONS

Type	Gear
Number of sections	Two
Rotation as seen from drive end	Counterclockwise
Output scavenge section [Using SAE 10W oil at 120°F (49°)]	31.4 U.S. gpm (118.8 lit/min)
At a speed of	2480 rpm
At a pressure of	0 psi (0.0 kg/cm²)
Output circulating section [Using SAE 10W oil at 120°F (49°C)]	21.3 U.S. gpm (80.6 lit/min)
At a speed of	2480 rpm
At a pressure of	40 psi (2.8 kg/cm²)

3P4855 TRANSMISSION OIL PUMP BENCH TEST SPECIFICATIONS	
Type	Gear
Number of sections	One
Rotation as seen from drive end	Clockwise
Output [Using SAE No. 10W oil at 120°F (49°C)]	32.9 U.S. gpm (124.5 lit/min)
At a speed of	1882 rpm
At a pressure of	415 psi (29.2 kg/cm²)

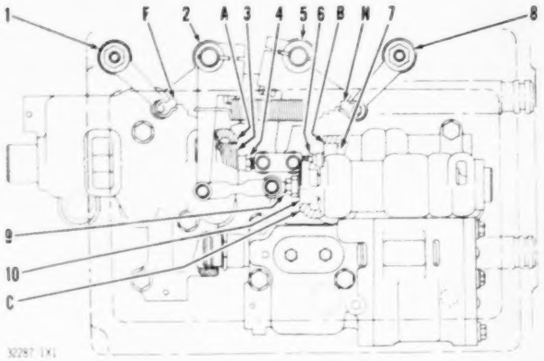
TRANSMISSION SELECTION	CLUTCHES ENGAGED IN TRANSMISSION
First Speed Forward	1 and 5
Second Speed Forward	1 and 3
Third Speed Forward	1 and 4
First Speed Reverse	2 and 5
Second Speed Reverse	2 and 3
Third Speed Reverse	2 and 4

LINKAGE ADJUSTMENT

WARNING: Do not make any adjustments to the linkage with the engine running.

Inside Adjustment

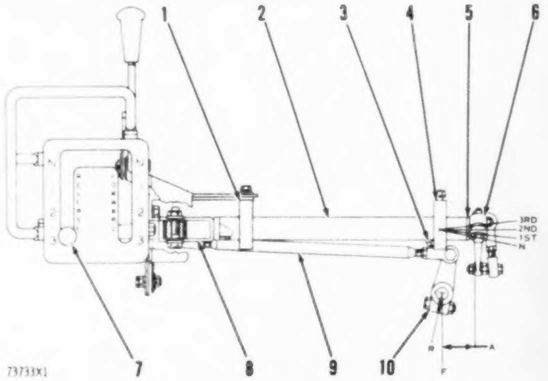
1. Move the selection lever to the NEUTRAL position.
2. Make sure detent (8) is engaged in NEUTRAL notch (N) of lever (5).
3. If detent (8) is not fully engaged in notch (N) of lever (5), make an adjustment to the linkage for speed selection. Make referenc to "Outside Adjustment".
4. Loosen nut (6). Turn safety valve (7) either clockwise or counterclockwise until the front face of the safety valve is even with face (B) of the safety and direction valve. Tighten nut (6).
5. Loosen nut (4). Turn spool for speed selection (3) either clockwise or counterclockwise until the front face of the spool is even with face (A) of the selection lever. Tighten nut (4).
6. Move the selector lever to the FORWARD position.
7. Make sure detent (1) is engaged in FORWARD notch (F) of lever (2).
8. If detent (1) is not fully engaged in notch (F) of lever (2), make an adjustment to the linkage for direction selection. Make reference to "Outside Adjustment".
9. Loosen nut (9). Turn spool for direction selection (10) either clockwise or counterclockwise until the front face of the spool is even with face (C) of the safety and direction valve. Tighten nut (9).



INSIDE LINKAGE ADJUSTMENT

1. Detent. 2. Lever. 3. Spool for speed selection. 4. Nut. 5. Lever. 6. Nut. 7. Safety valve. 8. Detent. 9. Nut. 10. Spool for direction selection. A. Face of selection valve. B and C. Faces of safety and direction valve. F. Forward notch of lever. N. Neutral notch of lever.

Outside Adjustment

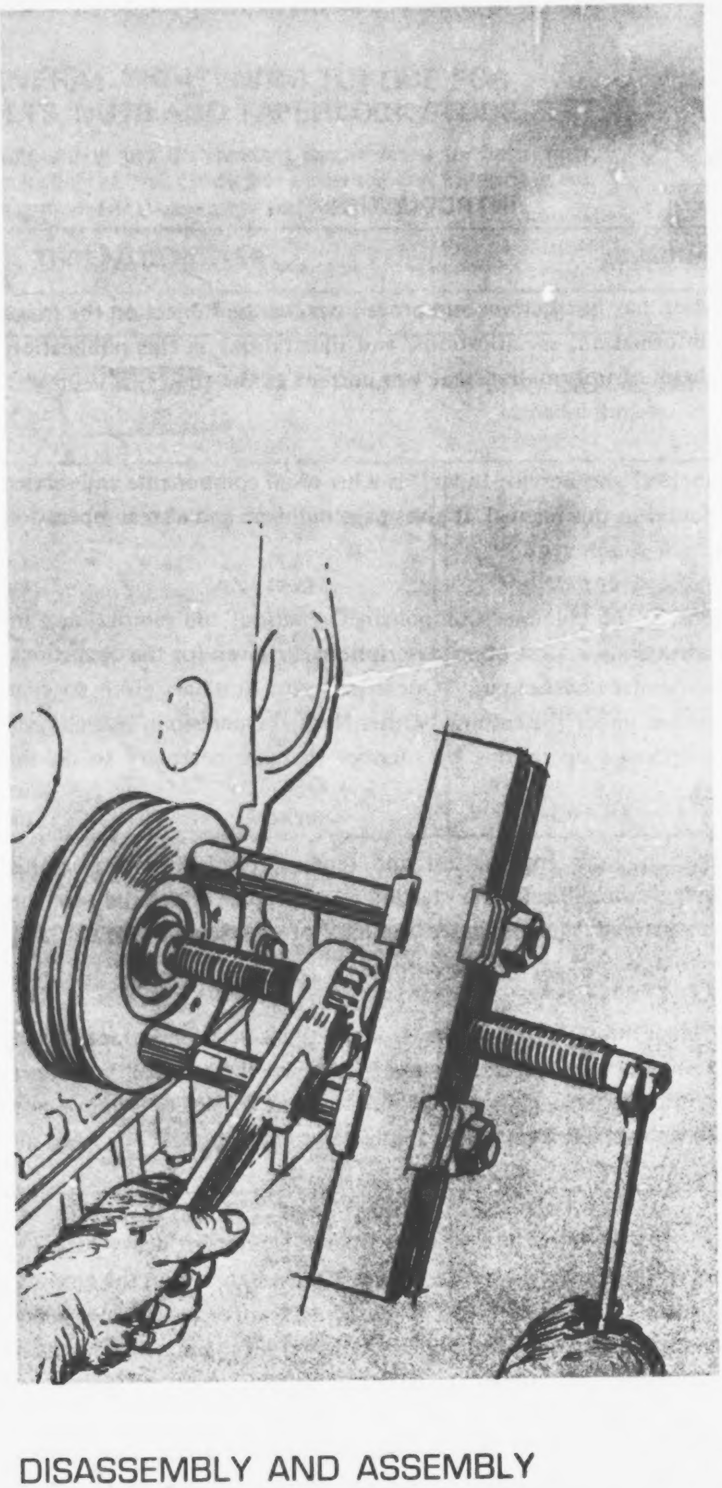


OUTSIDE LINKAGE ADJUSTMENT (Top View)

1. Clamp. 2. Support. 3. Lever. 4. Clamp. 5. Washer. 6. Lever. 7. Selection lever. 8. Shaft assembly. 9. Rod. 10. Lever. A. 1.82 in. (46.2 mm) dimension between center of transmission control shafts and left face of lever (6).

1. Loosen the bolts that hold lever (6) to shaft assembly (8). Put a thickness gauge between washer (5) and lever (6). Make an adjustment to the position of lever (6) so the distance between washer (5) and lever (6) is .030 ± .010 in. (0.76 ± 0.25 mm). Tighten the bolt.
2. Loosen the bolts that hold clamps (1) and (4). Make an adjustment to support (2) so dimension (A) is 1.82 in. (46.2 mm). Tighten the bolts for the clamps.
3. Disconnect the linkage from lever (10).
4. Move lever (10) to the FORWARD "F" detent.
5. Disconnect the linkage from lever (3).
6. Move lever (3) to the NEUTRAL "N" detent.
7. Move selection lever (7) to the center of the NEUTRAL opening of the shift guide.
8. Connect the link that is made by the rod ends to levers (6) and (3).
9. Move selection lever (7) to the FORWARD side of the NEUTRAL opening of the shift guide.
10. Make an adjustment to the length of rod (9) between levers (7) and (10). Connect the rod to levers (7) and (10).

NOTE: Install the nuts that hold the links of connection to the levers so that the chamfered side of the nuts are toward the ball section of the ends.



DISASSEMBLY AND ASSEMBLY

D8K POWER TRAIN

SERIAL NUMBERS
66V1-UP
76V1-UP
77V1-UP

INTRODUCTION

This publication has instructions and procedures for the subject on the front cover. The information, specifications, and illustrations in this publication are on the basis of information that was current at the time this issue was written.

The "Alphabetical and Service Index" is a list of all components and service operations found in this manual. It gives page numbers and also an operation number for each component.

All operations in the column "Component Operation" are removal and installation instructions, unless other descriptions are given for the operations. The numbers under the column "Operation" are numbers given to each operation for use under the column "Other Needed Operations" which gives all other component operations by number that are necessary to do the respective job.

Correct operation, maintenance, test and repair procedures will give this product a long service life. Before starting a test, repair or rebuild job, the serviceman must read the respective sections of the Service Manual, and know all the components he will work on.

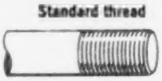
Your safety, and the safety of others, is at all times very important. When you see this symbol ⊕ or this symbol ⚠ in the manual, you must know that caution is needed for the procedure next to it. The symbols are warnings. To work safely, you must understand the job you do. Read all instructions to know what is safe and what is not safe.

It is very important to know the weight of parts. Do not lift heavy parts by hand. Use a hoist. Make sure heavy parts have a good stability on the ground. A sudden fall can cause an accident. When lifting part of a machine, make sure the machine has blocks at front and rear. Never let the machine hang on a hoist, put blocks or stands under the weight.

When using a hoist, follow the recommendation in the manual. Use correct lift tools as shown in illustrations to get the correct balance of the component you lift. This makes your work safer at all times.

GENERAL TIGHTENING TORQUE FOR BOLTS, NUTS AND TAPERLOCK STUDS

The following charts give the standard torque values for bolts, nuts and taperlock studs of SAE Grade 5 or better quality. Exceptions are given in the component Disassembly and Assembly.

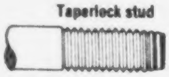


Use these torques for bolts and nuts with standard threads.

THREAD DIAMETER		STANDARD TORQUE	
inches	**millimeters**	**lb. ft.**	**mkg**
1/4	6.35	9 ± 3	1.24 ± 0.4
5/16	7.94	18 ± 5	2.5 ± 0.7
3/8	9.53	32 ± 5	4.4 ± 0.7
7/16	11.11	50 ± 10	6.9 ± 1.4
1/2	12.70	75 ± 10	10.4 ± 1.4
9/16	14.29	110 ± 15	15.2 ± 2.0
5/8	15.88	150 ± 20	20.7 ± 2.8
3/4	19.05	265 ± 35	36.6 ± 4.8
7/8	22.23	420 ± 60	58.1 ± 8.3
1	25.40	640 ± 80	88.5 ± 11.1
1 1/8	28.58	800 ± 100	110.6 ± 13.8
1 1/4	31.75	1000 ± 120	138 ± 16.6
1 3/8	34.93	1200 ± 150	166 ± 20.7
1 1/2	38.10	1500 ± 200	207 ± 27.7

Use these torques for bolts and nuts on hydraulic valve bodies.

5/16	7.94	13 ± 2	1.8 ± 0.3
3/8	9.53	24 ± 2	3.3 ± 0.3
7/16	11.11	39 ± 2	5.4 ± 0.3
1/2	12.70	60 ± 3	8.3 ± 0.4
5/8	15.88	118 ± 4	16.3 ± 0.5



Use these torques for studs with Taperlock threads.

1/4	6.35	5 ± 2	0.69 ± 0.3
5/16	7.94	10 ± 3	1.4 ± 0.4
3/8	9.53	20 ± 3	2.8 ± 0.4
7/16	11.11	30 ± 5	4.1 ± 0.7
1/2	12.70	40 ± 5	5.5 ± 0.7
9/16	14.29	60 ± 10	8.3 ± 1.4
5/8	15.88	75 ± 10	10.4 ± 1.4
3/4	19.05	110 ± 15	15.2 ± 2.0
7/8	22.23	170 ± 20	23.5 ± 2.8
1	25.40	260 ± 30	35.9 ± 4.1
1 1/8	28.58	320 ± 30	44.2 ± 4.1
1 1/4	31.75	400 ± 40	55 ± 5.5
1 3/8	34.93	480 ± 40	66 ± 5.5
1 1/2	38.10	550 ± 50	76 ± 7

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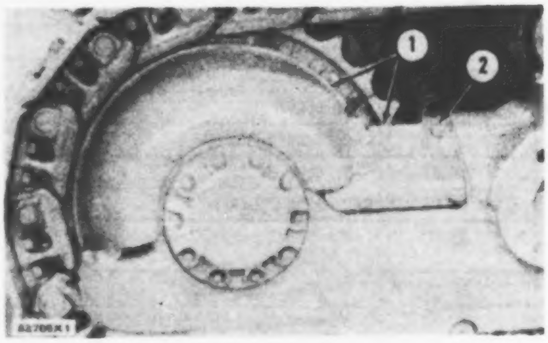
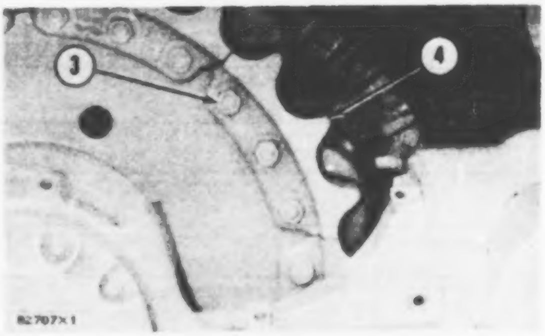
SPROCKET SEGMENTS

REMOVE SPROCKET SEGMENTS 11–4164

1. Remove bolts (2) and sprocket guards (1) from the track roller frame.

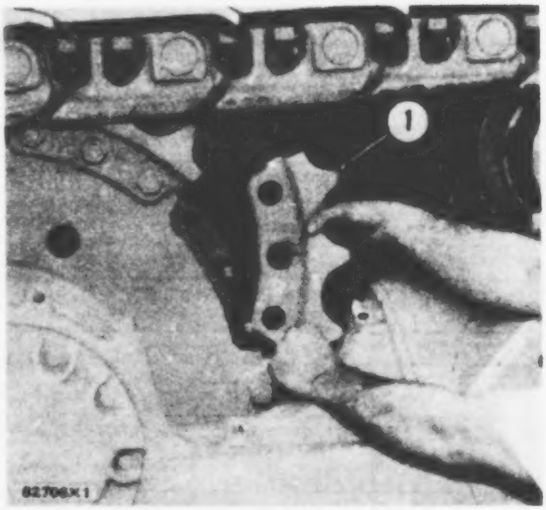


2. Move the machine forward or backward to put the sprocket in position to be removed.



3. Remove bolts and nuts (3) that hold the sprocket segment to the sprocket hub. Remove the sprocket segment (4).

INSTALL SPROCKET SEGMENTS 12–4164



1. Put each sprocket segment (1) in position on the sprocket hub. Put a high pressure lubricant on the threads of the bolts that hold the segments to the hub. Install the bolts and nuts (with the head of the bolt against the hub). Tighten all nuts to a torque of 250 ± 50 lb.ft. (34.6 ± 6.9 mkg). Tighten the nuts another 1/3 (120°) turn. The minimum amount of torque on the nuts is 650 lb.ft. (89.9 mkg) after the 1/3 (120°) turn.

2. Put the sprocket guards in position on the track roller frame. Install the bolts that hold the guards.

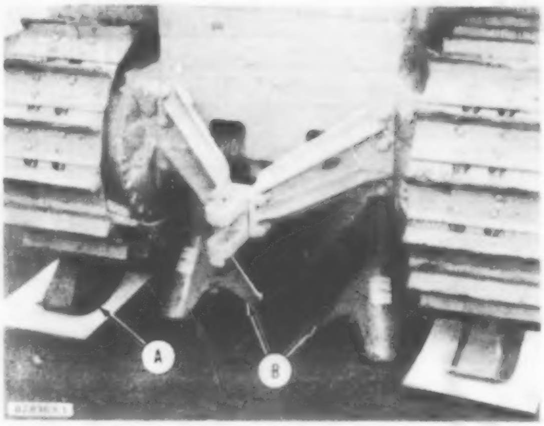
⚠ DISCONNECT BATTERIES BEFORE PERFORMANCE OF ANY SERVICE WORK

TRACK ROLLERS

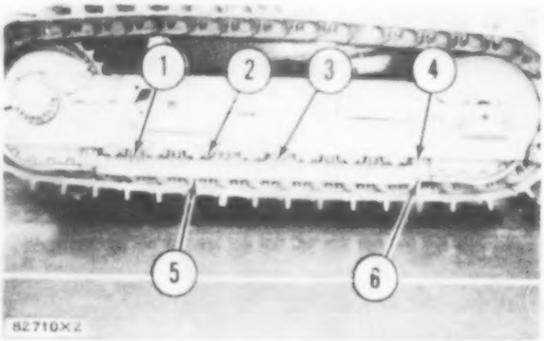
REMOVE TRACK ROLLERS 11–4130

Tools Needed		A	B	C
9S27	Lift Assembly	4		
8S7611	Tube		2	
8S7640	Stand		2	
8S7615	Pin		2	2
8S7621	Tube			2
8S7630	Stand			2

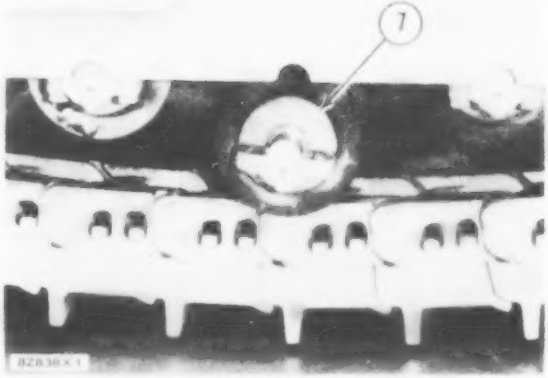
⚠ WARNING: The adjuster cylinder for the track is under high hydraulic pressure. Do not visually inspect the relief valve to see if grease is being released. Check the adjuster cylinder to see that it moves to the rear into the front pilot for the recoil springs. Use this warning any time that the track is loosened or tightened.



1. Start the tractor and move it to the rear up on tool (A). Put tooling (B) under the rear of the tractor. Put tool (A) under the front of the track. Move the tractor forward up on tool (A). Put tooling (C) under the front of the tractor. Remove tool (A) from the rear of the track. Move the tractor backward until the weight of the tractor is on tool (C). Remove tool (A) from the front of the tracks.



2. Move a fork lift truck under the outer guard for the track rollers. Remove nuts (1). Remove bolts (4) and retainers (6) from each end of the guard. Remove bolts (3) and spacers. Remove the outer guard (5). Weight is 175 lb. (79 kg).



3. Remove the tubes and rod assemblies from the inner guard. Fasten a hoist to the inner guard. Remove the bolts and retainer that hold the guard to the track frame. Lower the inner guard free of the track. Weight is 175 lb. (79 kg).

4. Tighten the track until it is tight against the track rollers. See TRACK ADJUSTMENT in TESTING AND ADJUSTING. Remove bolts (2) that hold each track roller.

5. Loosen the track to remove the track rollers (7). See TRACK ADJUSTMENT in TESTING AND ADJUSTING. Weight of each roller is 260 lb. (118 kg).

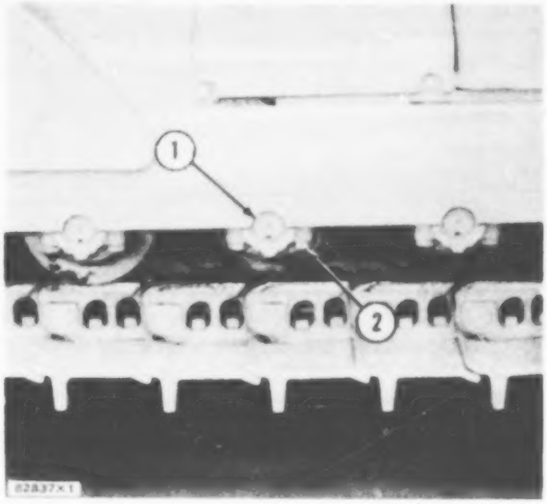
TRACK ROLLERS

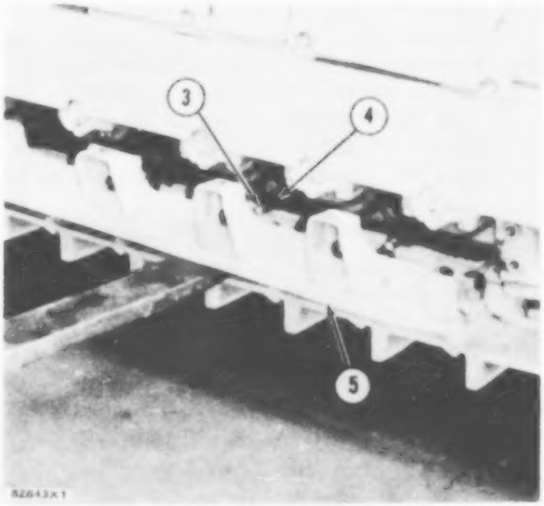
INSTALL TRACK ROLLERS 12–4180

Tools Needed		A	B	C	D
2P2256	Wrench	1			
2P2257	Extension	1			
2P2258	Adapter	1			
9S27	Lift Assembly		4		
8S7640	Stand			2	
8S7611	Tube			2	
8S7615	Pin			2	2
8S7630	Stand				2
8S7621	Tube				2

⚠ WARNING: The adjuster cylinder for the track is under high hydraulic pressure. Do not visually inspect the relief valve to see if grease is being released. Check the adjuster cylinder to see that it moves to the rear into the front pilot for the recoil spring. Use this warning any time that the track is loosened or tightened.

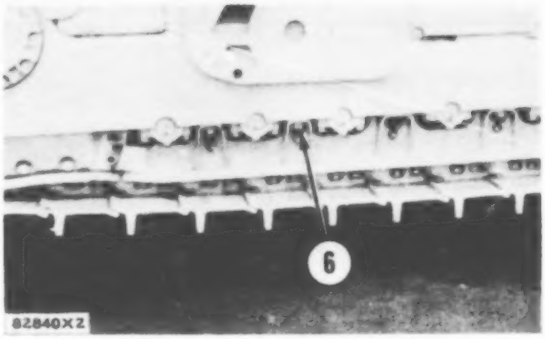
1. Put the track roller (1) in position on the track.
2. Lift the roller into position by tightening the track. See TRACK ADJUSTMENT in TESTING AND ADJUSTING.
3. Install bolts (2) that hold each roller to the track frame. Tighten the bolts to a torque of 800 ± 100 lb.ft. (110.6 ± 13.8 mkg).
4. Fasten a hoist to the inner guard and lift it into position on the track frame. Install the bolts in the top of the guard. Tighten the bolts to a torque of 800 ± 100 lb.ft. (110.6 ± 13.8 mkg) with tooling (A). Install the retainer and bolts that hold the front of the inner guard to the track frame. Tighten the bolts to a torque of 500 ± 50 lb.ft. (69.2 ± 6.9 mkg). Install rod assemblies (3) in the inner guard. Install the tubes (4) over the rod assemblies.
5. Put the outer guard (5) for the track rollers in position with a lift truck.





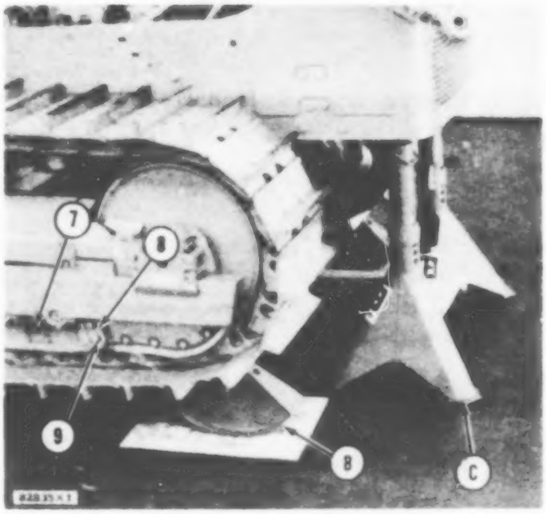
TRACK ROLLERS

6. Install bolts (6) that hold the guard to the track frame. Tighten the bolts to a torque of 800 ± 100 lb.ft. (110.6 ± 13.8 mkg). Push the rod assemblies (3) through the outer guard and install nuts (7). Tighten the nuts to a torque of 420 ± 60 lb.ft. (58.1 ± 8.3 mkg).



7. Install retainers (8) and bolts (9) on both ends of the outer guard. Tighten the bolts to a torque of 500 ± 50 lb.ft. (69.2 ± 6.9 mkg).

8. Install lift assemblies (B) under the front of the track. Start the machine and move it forward up on the lift assemblies. Remove tooling (D) from under the front of the tractor.



9. Install lift assemblies (B) under the rear of the track. Move the tractor backward up on the lift assemblies. Remove tooling (C) from under the rear of the tractor and the lift assemblies from the front of the track. Move the machine forward and remove the lift assemblies from the rear of the track.

10. Make an adjustment to the track. See TRACK ADJUSTMENT in TESTING AND ADJUSTING.

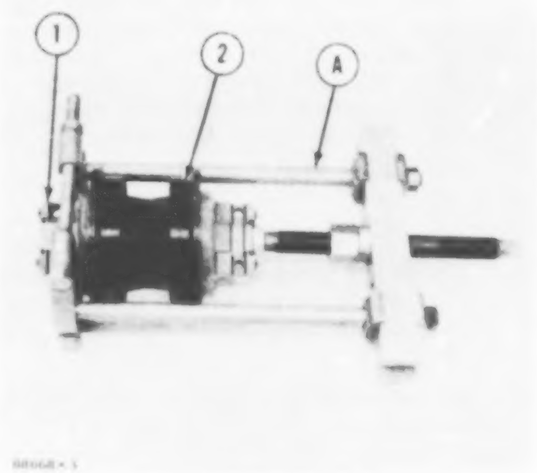
TRACK ROLLERS

DISASSEMBLE TRACK ROLLERS 15–4180

Tools Needed		A
1H3107	Puller Assembly	1
1H3108	Leg	2
1H3110	Bearing Pulling Attachment	1
9S9154	Step Plate	1

start by:
a) remove track rollers

1. Install tooling (A) on track roller (2). Put collar (1) under compression.

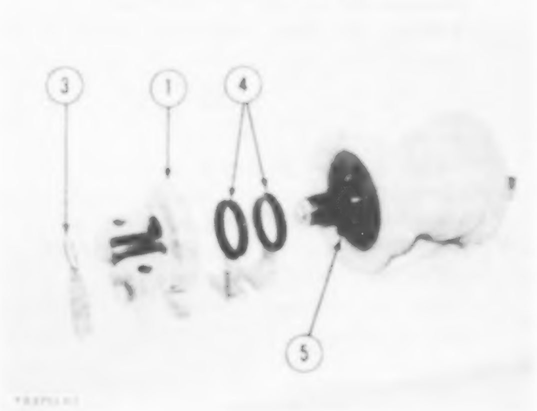


TYPICAL EXAMPLE

2. Remove ring (3). Remove collar (1). Remove Duo-Cone seals (4) from the collar and bushing.

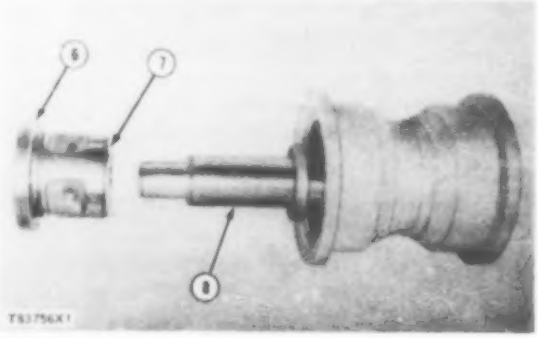
NOTE: Put identification on the Duo-Cone seals as to their location in the track roller to prevent mixing at assembly.

3. Follow the same procedure as in Steps 1, 2, and 3 to remove ring, collar, and Duo-Cone seals from the other end of the track roller.



4. Remove bolts (5) from each end of the track roller. Remove two bushings (6) and shaft (8) with a press.

5. Remove bearings (7) from the bushings with a press. Cut the pins even with the face of the bushings. Make the face of the bushing smooth with a file.



TRACK ROLLERS

ASSEMBLE TRACK ROLLERS 16–4180

Tools Needed		A	B	C	D
FT578	Bushing Alignment Tool	1			
8S2328	Dial Test Indicator Group		1		
5M2160	Seal Installer			1	
1H3107	Puller Assembly				1
1H3108	Leg				2
1H3110	Bearing Pulling Attachment				1
9S9154	Step Plate				1

1. Put the oil holes in bearing (1) in alignment with the oil holes in bushing (3). Install the bearing in the bushing with a press. Drill two .297 in. (7.54 mm) diameter holes 180° apart through the bearing and into the bushing. Drill the holes .75 in. (19.1 mm) deep.

CAUTION: Do not drill the holes through the lubrication grooves in the face of the bearing flange.

2. Install two new pins (2) even with the outside face of the bearing.

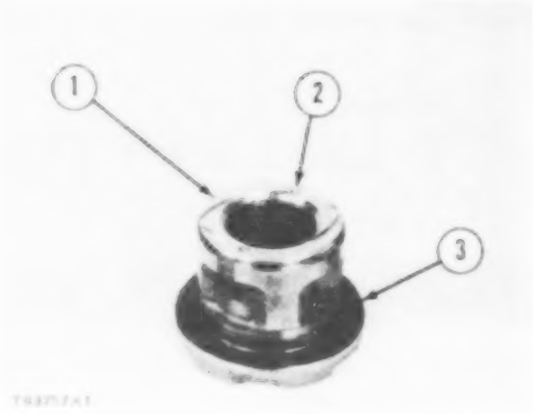
3. Install the bearing in the other bushing following the same procedure as in Steps 1 and 2.

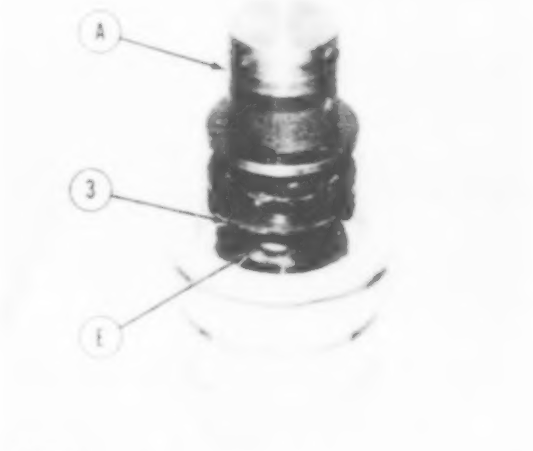
4. Install new O-ring seals on the bushings. Put lubricant on the O-ring seals. Install bushing (3) in the roller with tool (A) and a press. Install the six bolts that hold it.

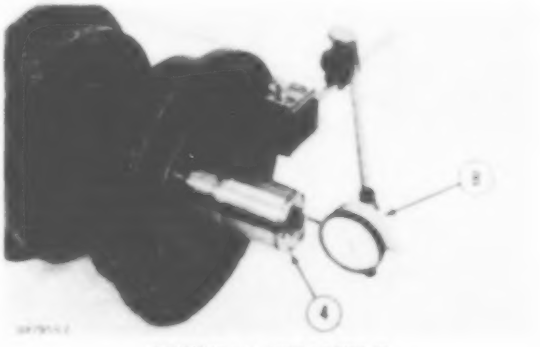
NOTE: Check the diameter of shaft (4). Check the amount the shaft is bent. Check the clearance between the shaft and its bearings. See TRACK ROLLERS in POWER TRAIN SPECIFICATIONS.

5. Install the shaft in the bushing and roller. Put 9M3710 Anti-Seize Compound on surface (E) of the bushing. Install the other bushing in the roller with tool (A) and a press. Install the bolts that hold it.

6. Install tool group (B) and make a check of the end clearance for the shaft. The end clearance must be .0285 in. (0.724 mm) maximum or .0115 in. (0.292 mm) minimum.



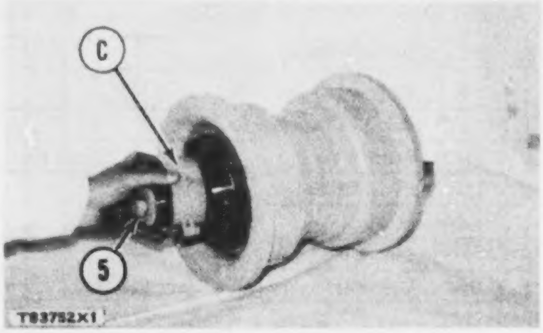




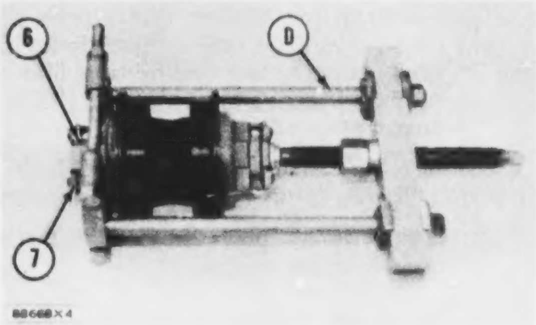
TYPICAL EXAMPLE

TRACK ROLLERS

7. Make sure the Duo-Cone seals (8) and (9), and all metal surfaces that are in contact with the seals are clean and dry. Install the seals in the bushings and collars with tool (C). Put a light amount of oil on the metal surfaces of the seals that make contact with each other. Put lubricant on O-ring seals (10) and (11). Install collars (12) and (13) on the shaft.

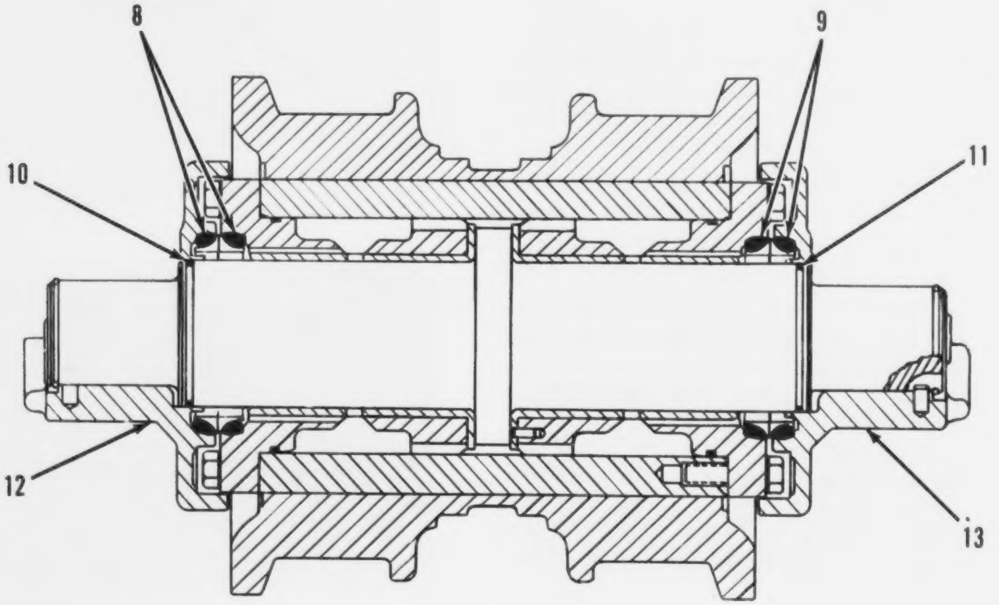


8. Install tooling (D) on one end of the shaft. Put collar (7) under compression. Install ring (6) on the shaft. Follow the same procedure and install the ring on the opposite end of the shaft.



9. Put the track roller in a horizontal position. Remove plug (5). Fill the roller with oil. See TRACK ROLLER LUBRICATION in SYSTEMS OPERATION. Install the plug. Tighten the plug to a torque of 125 ± 15 lb.ft. (17.3 ± 2.1 mkg).

end by:
  a) install track rollers



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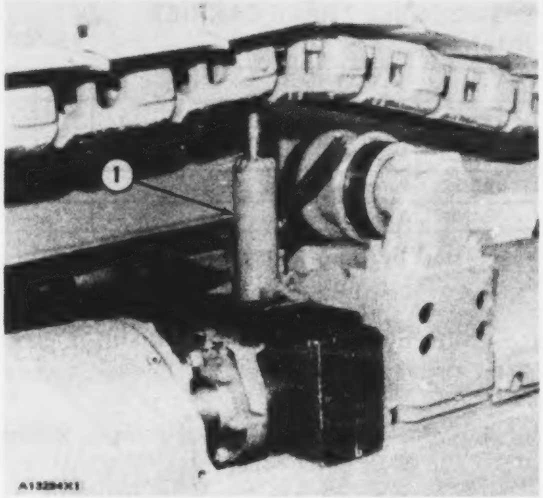
TRACK CARRIER ROLLERS

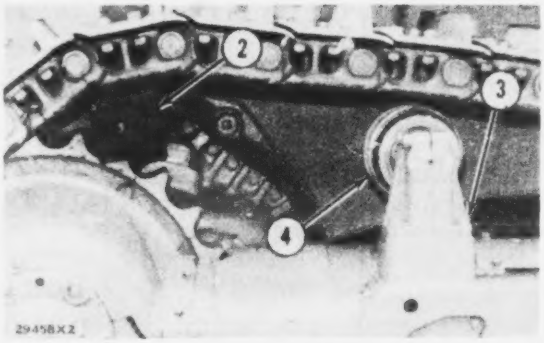
REMOVE TRACK CARRIER ROLLERS 11–4154

⚠ WARNING: The adjuster cylinder for the tracks is under high hydraulic pressure. Do not visually inspect the relief valve to see if grease is released. Check the adjuster cylinder to see that it moves to the rear into the front pilot of the recoil springs. Use this warning any time the track is loosened or tightened.

1. Loosen the track. See, TRACK ADJUSTMENT in TESTING AND ADJUSTING.
2. Remove the front track carrier roller as follows:
    a) Remove the guard over the track adjuster.
    b) Put hydraulic jack (1) in position under the track as shown. Lift the track off of the track carrier roller.
    c) Fasten a hoist to the track carrier roller. Remove the bolts that hold it in position. Remove the track carrier roller. Weight of the track carrier roller is 130 lb. (59 kg).

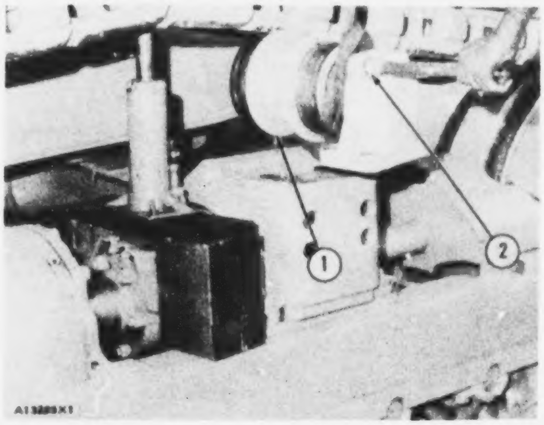


3. Remove the rear track carrier roller as follows:
    a) Install a wood block (2) between the sprocket and the track. Move the machine to the rear until the track is off of the track carrier roller.
    b) Fasten a hoist to the track carrier roller. Remove the bolts that hold it in position. Remove the track carrier roller. Weight of the rear track carrier roller is 130 lb. (59 kg).



INSTALL TRACK CARRIER ROLLER 12–4154

1. Fasten a hoist to the track carrier roller (1). Put the track carrier roller in position on the support. Install the four bolts that hold it.
2. Remove the hydraulic jack or wood block from under the track.
3. If the track carrier roller was disassembled, make an adjustment to put the track carrier roller in alignment with the front idler and the sprocket.
4. Loosen bolts (2). Move the track carrier roller in or out until there is a distance of .06 in. (1.5 mm) between the end collar of the track carrier roller and the outer face of the bracket.
5. Make an adjustment to the track. See, TRACK ADJUSTMENT in TESTING AND ADJUSTING.



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TRACK CARRIER ROLLERS

DISASSEMBLE TRACK CARRIER ROLLERS 15–4154

Tools Needed		A	B	C
1P2321	Puller Assembly	1		
8B7560	Step Plate	1	1	
1P2322	Puller Assembly		1	
1S4207	Spanner Wrench			1

start by:
a) remove track carrier roller

1. Remove the bracket from the track carrier roller.

2. Remove the plug from the cover. Remove the oil from the roller.

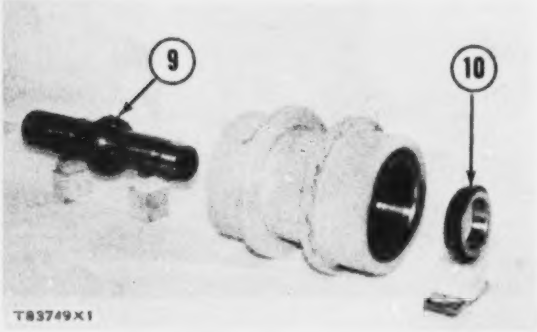
3. Remove spiral snap ring (1). Remove the end collar (2). Remove two Duo-Cone seals (3).

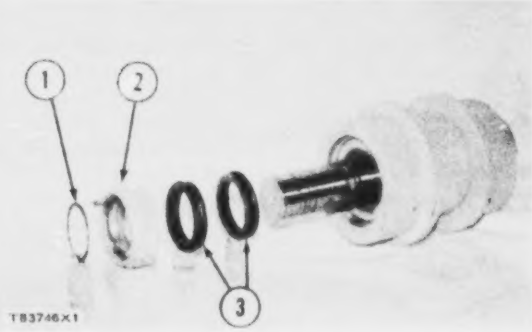
NOTE: Put identification on the Duo-Cone seals to prevent mixing at assembly.

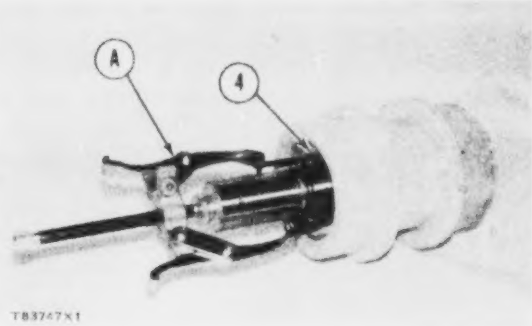
4. Install two 5/16"–18NC forcing screws in seal support (4). Install tooling (A) and remove the support.

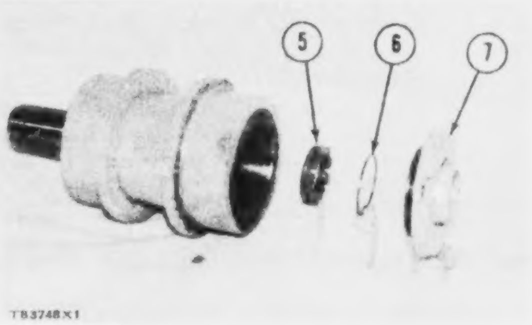
5. Remove the bolts and cover (7). Remove lock ring (6) from nut (5). Remove the nut with tool (C).

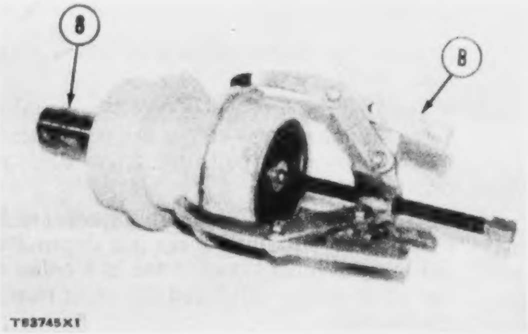
6. Remove the shaft (8) from the roller with tooling (B). Remove bearing cone (10) from the roller. Remove bearing cone (9) from the shaft. Remove the two bearing cups from the roller.









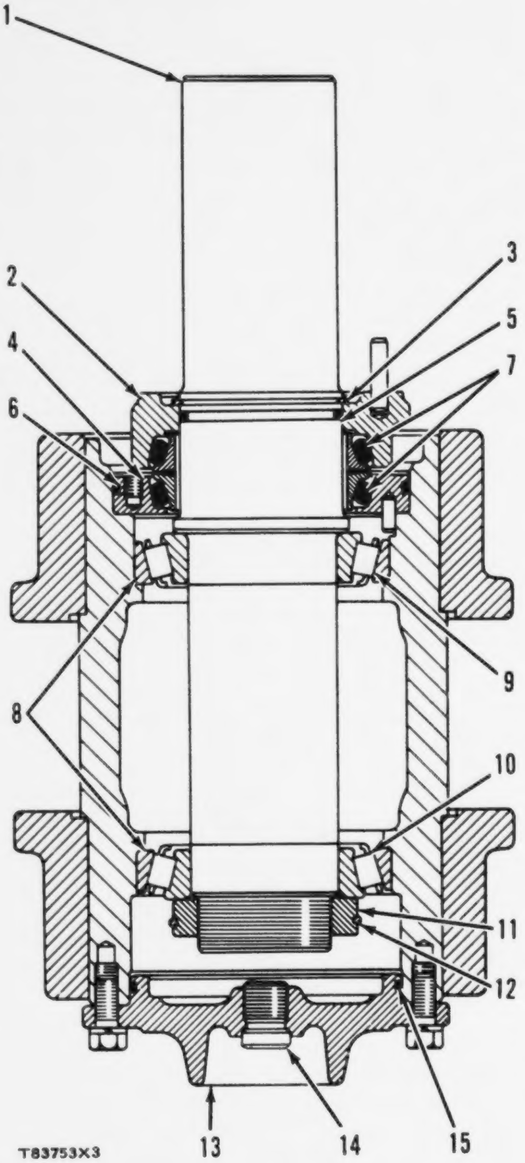


TRACK CARRIER ROLLERS

ASSEMBLE TRACK CARRIER ROLLERS 16–4154

Tools Needed		A	B
1S4207	Spanner Wrench	1	
5M2158	Installer Assembly		1

1. Lower the temperature of bearing cups (8). Install the bearing cups in the roller.
2. Heat the two bearing cones (9) and (10) in oil to a maximum temperature of 275°F (135°C). Install bearing cone (9) on the shaft (1). Install the shaft in the roller. Install bearing cone (10) on the shaft.
3. Install nut (11) on the shaft with tool (A). Tighten the nut until all bearing end clearance is removed and a small amount of preload is felt on the bearings when turning the shaft. Loosen the nut until the nearest hole in the nut is in alignment with the hole in the shaft. Install lock ring (12).
4. Put lubricant on the O-ring seal (15). Install the cover (13) and the bolts that hold it.
5. Put lubricant on O-ring seal (6). Install the seal support (4). Make sure the dowel in the support is in alignment with its groove (slot) in the roller.
6. Make sure the Duo-Cone seals (7) and all metal surfaces that are in contact with the seals are clean and dry. Install the seals in the roller and end collar (2) with tool (B).
7. Put lubricant on the O-ring seal (5). Put a small amount of oil on the surfaces of the Duo-Cone seals that make contact with each other. Install the end collar. Install spiral snap ring (3).
8. Put the track carrier roller in a horizontal position. Fill the roller with oil. See TRACK CARRIER ROLLER LUBRICATION in SYSTEMS OPERATION. Install plug (14). Tighten the plug to a torque of 125 ± 15 lb.ft. (17.3 ± 2.1 mkg).



end by:
   a) install track carrier rollers

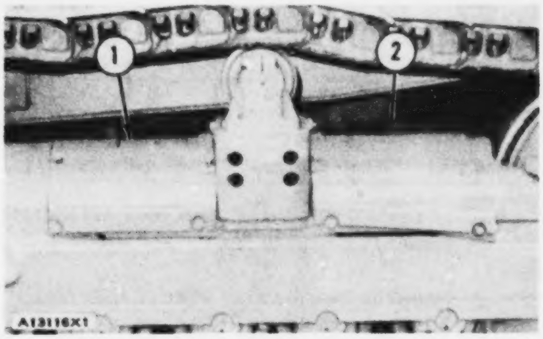
EQUALIZER BAR

REMOVE EQUALIZER BAR 11–7206

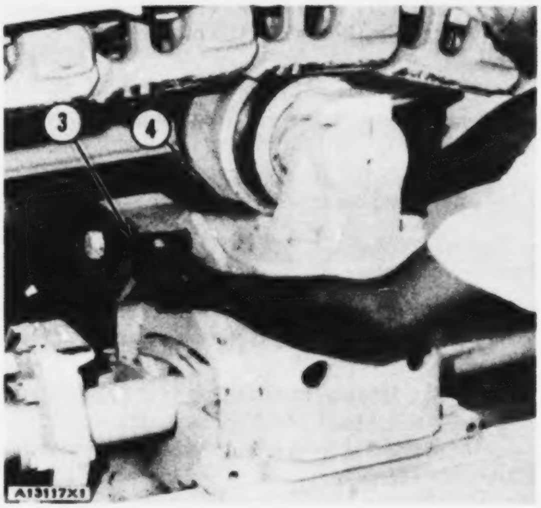
Tools Needed		A	B
8S7645	Hose Group	1	
8S7650	Cylinder Group	2	
8S7630	Stand	2	2
8S7631	Tube	2	2
8S7615	Pin	4	2
3S6224	Pump Group	1	

start by:
a) remove crankcase guard (front)

⚠ WARNING: The adjusters for the cylinders are under high hydraulic pressure. Do not visually inspect the relief valves to see if grease is released. Check the adjuster cylinders to see that they move to the rear into the front pilot of the recoil springs.



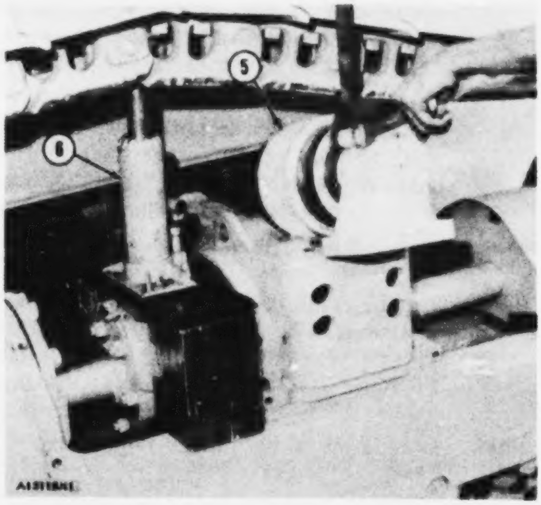
1. Remove guards (1) and (2) on both sides of the machine.



2. Remove bolt (3) and sleeve (4) from both sides of the machine.

3. Put a hydraulic jack under the track as shown. Lift the track off of the track carrier roller.

⚠ WARNING: Make sure the hydraulic jack (6) is tight against the track roller frame when the track is lifted.



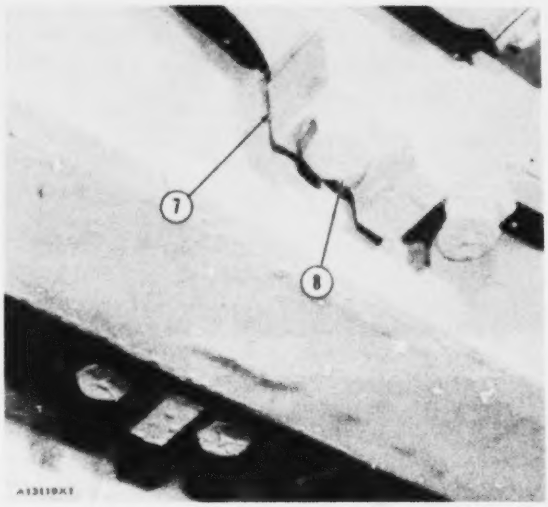
4. Remove the four bolts that hold the track carrier roller in position.

5. Fasten a hoist to the track carrier roller. Remove the track carrier roller (5). Weight of the track carrier roller is 130 lb. (59 kg).

6. Remove the track carrier roller from the other side of the machine. Follow Steps 3 through 5.

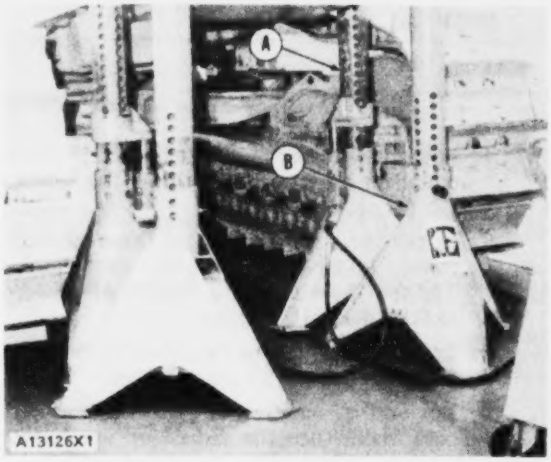
EQUALIZER BAR

7. Remove four bolts (8) and two caps (7) from the equalizer bar.



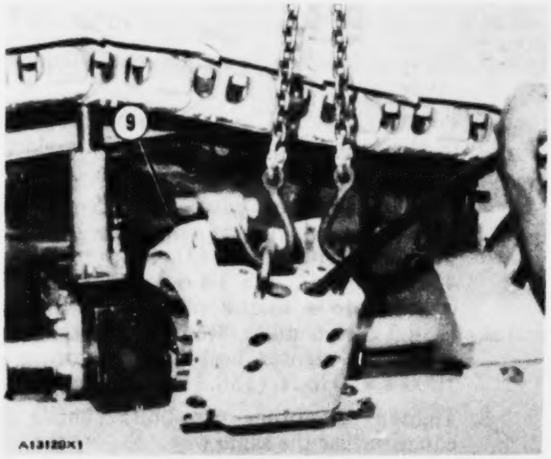
8. Put tooling (A) in position under the frame of the machine. Lift the front of the machine until the saddle of the frame is off of the equalizer bar. Put tooling (B) in position under the front radiator guard.

9. Put a floor jack in position under the equalizer bar. Lift the equalizer with the floor jack until both ends of the equalizer bar are out of the supports for the track carrier rollers.



10. Remove the six bolts that hold support (9) in position.

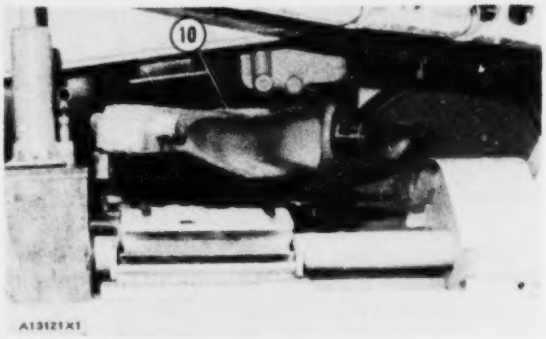
11. Fasten a hoist to the support. Remove the support. Weight of the support is 146 lb. (66.2 kg).



NOTE: The support does not have to be removed from the other side of the machine.

EQUALIZER BAR

12. Turn the equalizer bar (10) until it can be lowered and removed from under the machine. Weight of the equalizer bar is 580 lb. (263 kg).



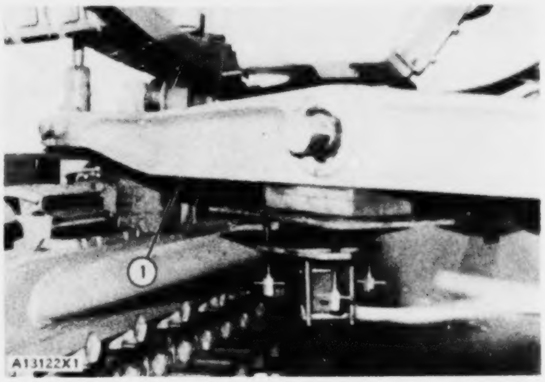
INSTALL EQUALIZER BAR 12–7206

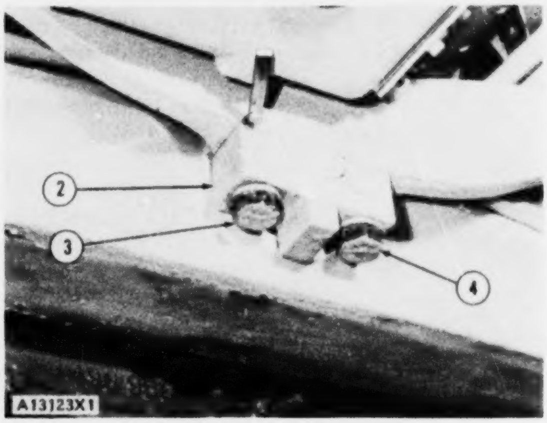
Tools Needed		A	B
8S7645	Hose Group	1	
8S7650	Cylinder Group	2	
8S7630	Stand	2	2
8S7631	Tube	2	2
8S7615	Pin	4	2
3S6224	Pump Group	1	

1. Put equalizer bar (1) on a floor jack. Put the equalizer bar in position under the saddle of the frame.
2. Install the right support for the track carrier roller. Install the six bolts that hold it. Tighten the bolts to a torque of 550 ± 75 lb.ft. (76.1 ± 10.4 mkg).
3. Lower the equalizer bar down in to the supports for the track carrier rollers.
4. Lower the machine down on the equalizer bar. Make sure the saddle of the frame is over the center pin in the equalizer bar.

NOTE: Make sure the equalizer bar is in the center of both supports for the track carrier rollers.

5. Remove tooling (A) and (B) from under the machine.
6. Put two caps (2) in position on the saddle of the frame. Install the bolts that hold the caps in position. Do not tighten the bolts.
7. Install a thickness gauge of .015 in. (0.38 mm) between the cap and the saddle as shown. Tighten bolt (3) to a torque of 400 ± 50 lb.ft. (55.3 ± 6.9 mkg). Tighten bolt (4) to a torque of 1000 ± 120 lb.ft. (138.3 ± 16.6 mkg). Remove the thickness gauge and tighten bolt (3) to a torque of 1000 ± 120 lb.ft. (138.3 ± 16.6 mkg).
8. Tighten the other cap bolts behind the equalizer bar the same way.

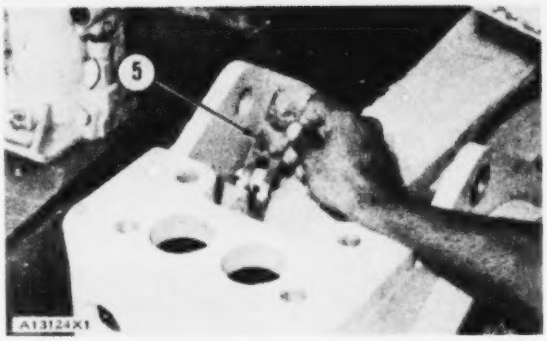




EQUALIZER BAR

9. Make sure the track roller frames are level and at the same height.

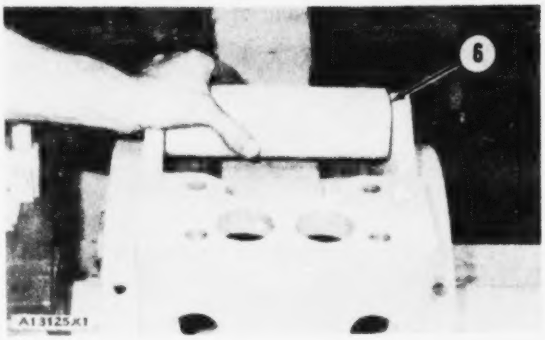
10. Put shims (5) on the outside wear plates until the wear plates make contact with the machined surfaces of the pins in the ends of the equalizer bar.



A13124X1

11. Put shims on the inside wear plates until there is a distance of .19 ± .03 in. (48.8 ± 0.8 mm) between the wear plate and the machines surfaces of the pins in the ends of the equalizer bar.

12. Install sleeves (6) on both sides of the machine. Install the nuts and bolts that hold the sleeves in position.



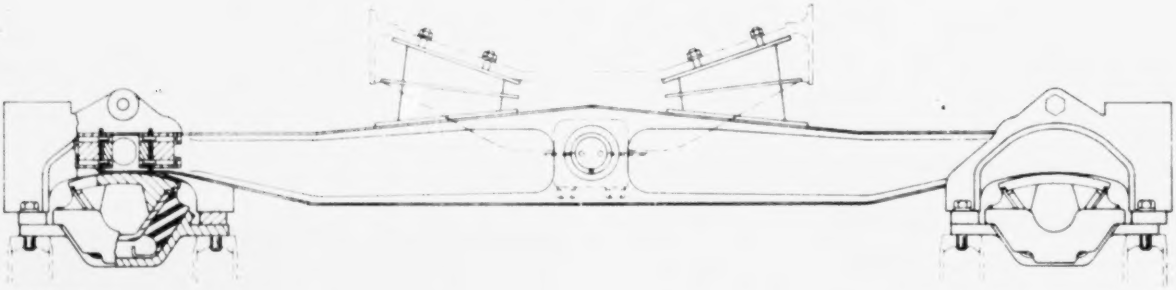
A13125X1

13. Install the carrier rollers on both sides of the machine.

14. Lower the track down on the carrier rollers. Remove the hydraulic jacks from the track roller frames.

15. Install the two guards over the track roller frame on both sides of the machine.

end by:
  a) install crankcase guard (front)

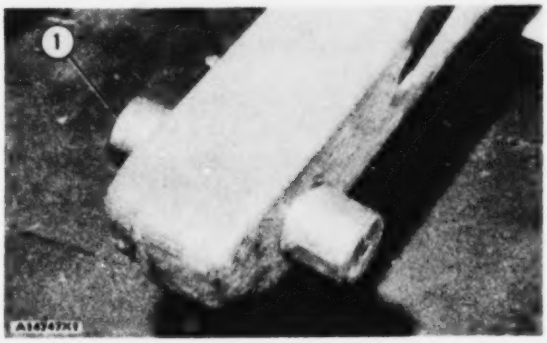


A11931X3

EQUALIZER BAR

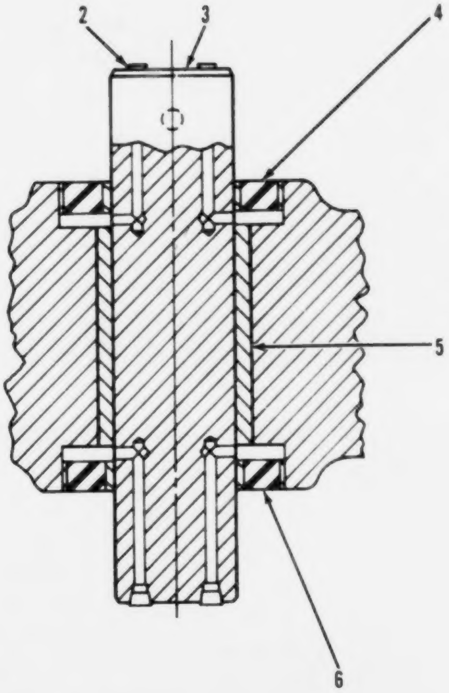
DISASSEMBLE EQUALIZER BAR 15–7206

start by:
a) remove equalizer bar



1. Remove two pins (1) from each end of the equalizer bar with a 100 ton (91 t) press.

2. Remove plugs (2) from the center pin of the equalizer bar. Remove the oil from the equalizer bar.



A15126X1

3. Remove center pin (3) with a 100 ton (91 t) press.

4. Remove seals (4) and (6) from the equalizer bar.

5. Remove bearing (5) from the equalizer bar.

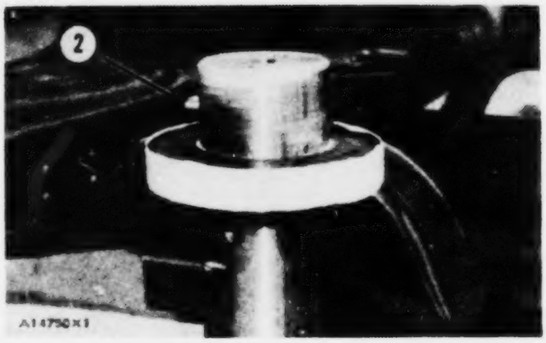
ASSEMBLE EQUALIZER BAR 16–7206

Tools Needed		A	B	C
1P532	Handle	1		1
1P495	Drive Plate	1		1
1P526	Drive Plate	1		
FT1228	Driver Assembly		1	
1P524	Drive Plate			1
1P513	Drive Plate			1
1P504	Drive Palte			1

1. Put No. 92-41 Pipe Sealant on the inner bore of seal (1). Install the seal on the end of the center pin that has the dowel hole.

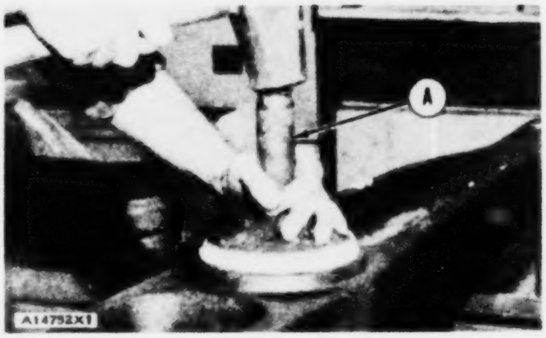
EQUALIZER BAR

2. Put No. 92-41 Pipe Sealant on the outside diameter of the seal. Install dowel pin (2) in the center pin.



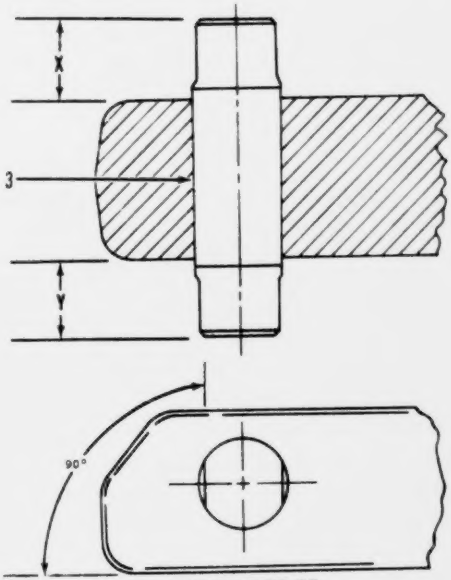
A14750X1

3. Check the bore in the equalizer bar for defects. The bore must be clean and smooth. Put No. 92-41 Pipe Sealant in the bore of the equalizer bar. Put No. 92-41 Pipe Sealant on the outside diameter of the other seal. Install the seal in the equlaizer bar with tooling (A). Put No. 92-41 Pipe Sealant on the inner bore of the seal.



A14752X1

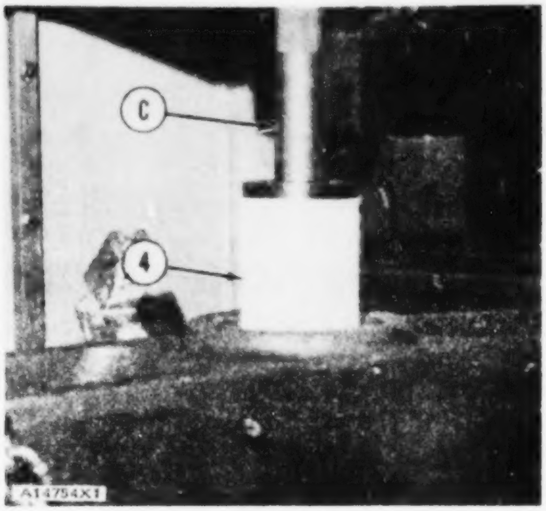
4. Put the equlaizer bar in a 100 ton (91 t) press with the seal in the equalizer bar on the bottom. Lower the temperature of the two pins (3). Install the pins with a 100 ton (91 t) press until dimensions (X) and (Y) are the same. Make sure the machined surfaces of the pins are at an angle of 90° to the bottom side of the equalizer bar.



A15127X1

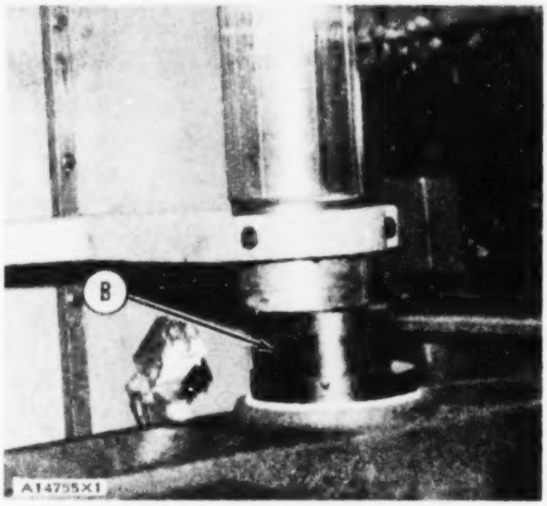
EQUALIZER BAR

5. Lower the temperature of bearing (4). Install the bearing in the equalizer bar with tooling (C) and a 100 ton (91 t) press. Install the bearing even with the bottom of the counterbore in the equalizer bar.

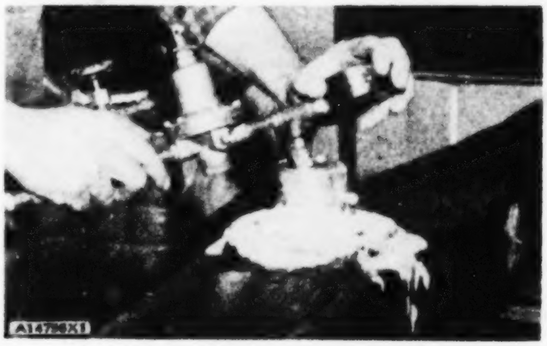


6. Put a support under the seal in the equalizer bar to prevent it from being pushed out when the other seal and center pin are installed.

7. Put No. 92-41 Pipe Sealant in the counterbore of the equalizer bar. Install the center pin and seal in the equalizer bar so that the dowel is at a 90° angle to the bottom side of the equalizer bar. Install the center pin and seal with tool (B) and a 100 ton (91 t) press.



8. Put one plug in each end of the center pin. Install an air nozzle as shown to check for leakage. Put a soap solution around the seal and force air at 20 psi (1.41 kg/cm²) into the center pin. If the seals do not leak, remove the air nozzle and clean the pipe sealant from around the equalizer bar.



9. Remove the plugs and fill the center pin with 2.25 oz. (60.7 cc) of clean SAE 90 oil. Install the plugs in the center pin.

end by:
   a) install equalizer bar

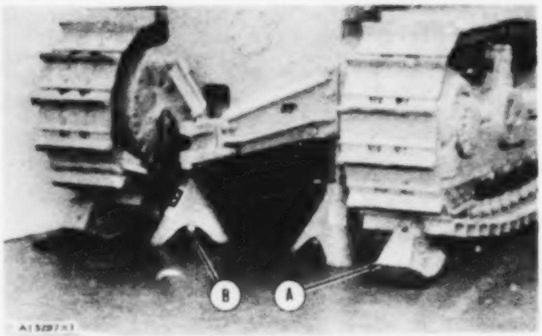
TRACKS

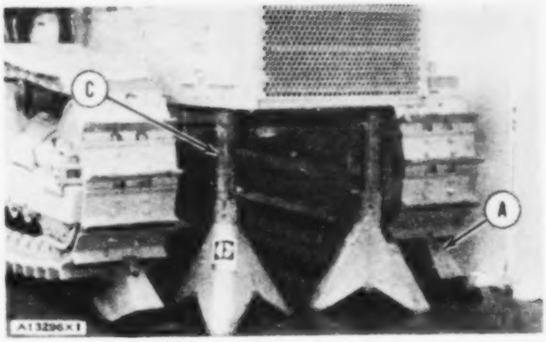
SEPARATION OF TRACKS

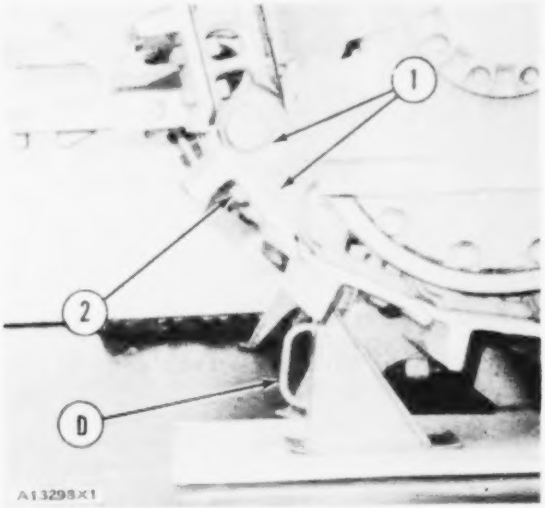
Tools Needed		A	B	C	D	E	F
9S27	Lift Assembly	4					
8S7640	Stand		2				
8S7611	Tube		2				
8S7615	Pin		2	2			
8S7630	Stand			2			
8S7621	Tube			2			
8S7625	Collar			2			
1P3532	Track Block				1		
1P3545	Tool Group					1	
1P7402	Coupling Tool Group						1

WARNING: Make sure the hydraulic pressure in track adjusting mechanism is completely released and the cylinder can be moved to the rear into the front pilot for the recoil spring before making a separation of the track or installing the track adjusting mechanism. On machines with badly worn tracks, it is possible for the hydraulic track adjuster to have a maximum forward adjustment and the stop will be against the front support for the track roller frame. The hydraulic track adjuster is under high pressure. Do not visually inspect the relief valve to see if grease is being released. Check the adjuster cylinder to see that it moves to the rear into the front pilot for the recoil spring. Use this warning any time that the track is loosened or tightened.

1. Remove all foreign material that can prevent the front idler from moving forward or backward.
2. Start the tractor and move it to the rear up on tool (A). Put tooling (B) under the rear of the tractor. Put tool (A) under the front of the tracks. Move the tractor forward up on tool (A). Put tooling (C) under the front of the tractor. Remove tool (A) from the rear of the tracks. Move the tractor to the rear until the weight of the tractor is on tooling (B) and (C). Remove tool (A) from the front of the tracks.
3. Loosen the track. See TRACK ADJUSTMENT in TESTING AND ADJUSTING.
4. Move the track until the master link (1) is just below a horizontal line through the center of the sprocket. Install tool (D) under the grouser bar just below the master link. Move the track to the rear until it is in rigid contact with tool (D).

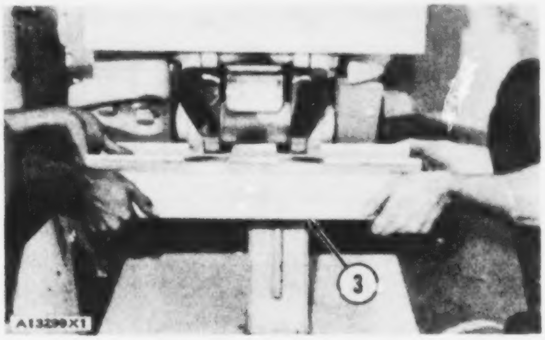




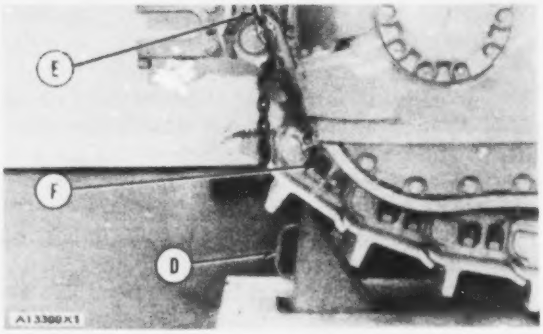


TRACKS

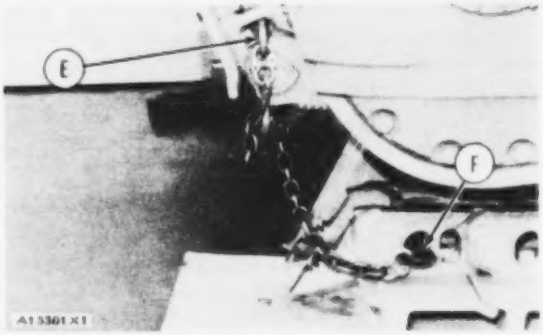
5. Remove bolts (2) and master shoe (3). Weight is 70 lb. (32 kg).



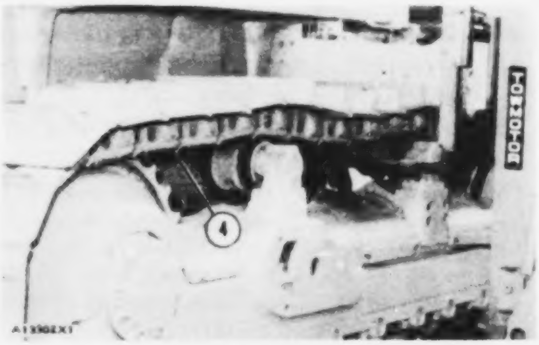
6. Install tool (F) in the opening of the link strut below the master link. Install the pin end of tool group (E) in the opening above the master link. Connect tool group (E) to tool (F). Start the tractor and turn the sprocket clockwise. Remove tool (D).



7. Turn the sprocket counterclockwise until the lower section of the track is on the floor and the tension is released from tool group (E) and tool (F). Remove tool group (E) and tool (F).



8. Turn the sprocket clockwise until the track is free of the sprocket.



9. Push the track (4) forward off the carrier rollers and the idler roller with a lift truck or hoist. Weight is 5550 lb. (2517 kg).

TRACKS

CONNECTION OF TRACKS

Tools Needed		A	B	C	D	E	F	G	H
1P3545	Chain Coupling Tool Group	1							
1P3533	Carrier Bar		1						
FT956	Channel Guide Bar			1					
1P7402	Coupling Tool Group				1				
1P3532	Track Block					1			
8S7630	Stand						2		
8S7621	Tube						2		
8S7625	Collar						2		
8S7615	Pin						2	2	
8S7640	Stand							2	
8S7611	Tube							2	
9S27	Lift Assembly								4

1. Install tool (A) as follows:
   a) Install pin (2) in the link strut opening of the track.
   b) Engage the chain hook of pin (3) in the seventh link of the chain.
   c) Engage the hook (1) in the sprocket segment.

2. Start the tractor and move the sprocket clockwise. Make sure the track is pulled up and on to the sprocket. Stop the rotation when the end of the track is just forward of a vertical line through the center of the sprocket. Remove tool (A).

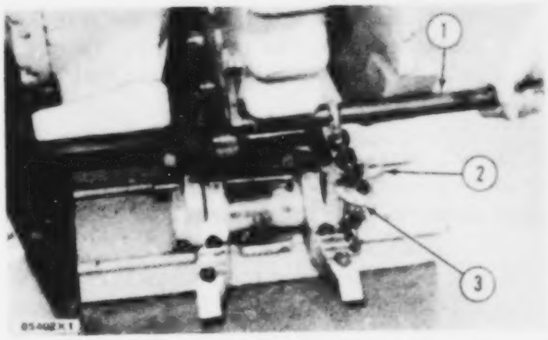
3. Install tool (B) below the first bushing and between the second track shoe and the top of the second bushing.

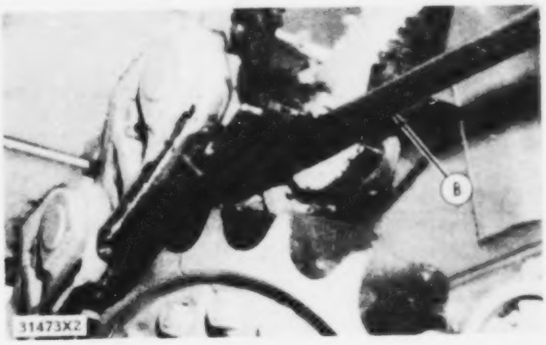
4. Install tool (C) between the carrier rollers.

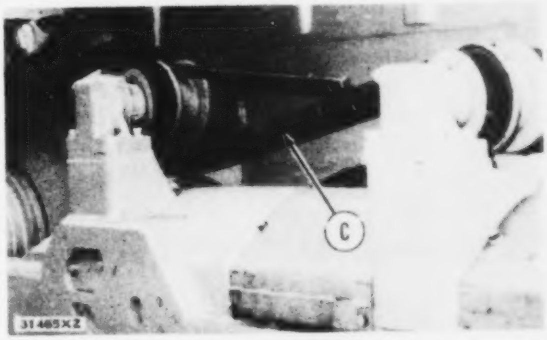
5. Start the tractor and move the sprocket clockwise until tool (B) has moved on the front idler. Remove tool (C). When the track moves on the front idler, remove tool (B).

6. Move the sprocket clockwise again until the top of track is almost on the floor.

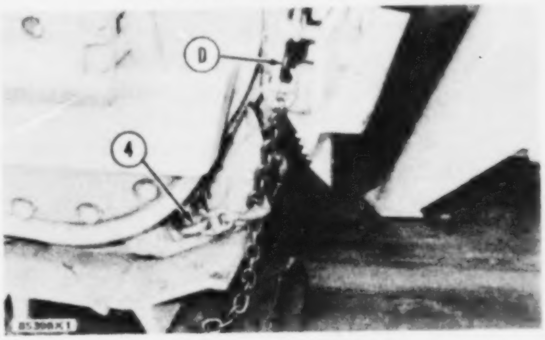
7. Install tool (D) in the link strut opening in one end of the track and the pin (4) end of tool (A) in the link strut opening of the other end of the track. Connect the hook and chain.





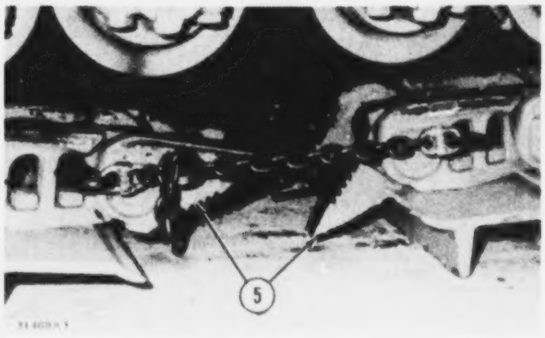


TYPICAL EXAMPLE



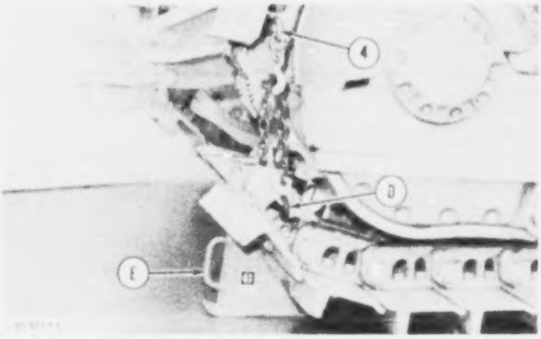
TRACKS

8. Start the tractor and move the sprocket clockwise until the master link is slightly below a horizontal line through the center of the sprocket.



CAUTION: Make sure the ends of the master link (5) are in a position to prevent damage when being pulled under the track roller frame.

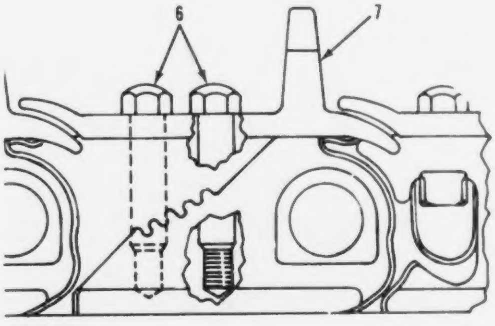
9. Put tool (E) under the first grouser of the lower end of the track. Turn the sprocket counterclockwise until the grouser is in contact with tool (E). Remove tool (D) and the pin (4).



10. Make sure the bushings are completely engaged in the sprocket segments.

11. Put the lower end of the master link in alignment with the upper end. Make sure the teeth of both ends of the master link are engaged.

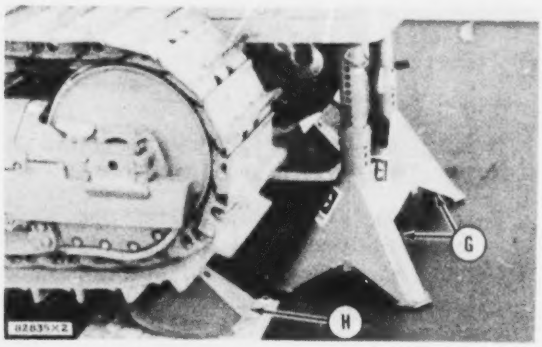
12. Put the master shoe (7) in position on the master link. Put a high pressure lubricant on the threads of the master link bolts. Install the bolts (6) that hold the master shoe and master link together. Tighten the bolts to a torque of 250 ± 50 lb.ft. (34.6 ± 6.9 mkg). Then tighten the bolts another one half turn.



32368X3

13. Remove tool (E).

14. Put tool (H) under the front of the tracks. Start the tractor and move it forward up and on tool (H). Remove tooling (F) from under the front of the tractor. Put tool (H) under the rear of the tracks. Move the tractor to the rear up and on tool (H). Remove tooling (G) from under the rear of the tractor. Remove tool (H) from the front of the tracks. Move the tractor forward and remove tool (H) from the rear of the tracks.



15. Make an adjustment to the tracks. See TRACK ADJUSTMENT in TESTING AND ADJUSTING.

TRACKS

DISASSEMBLE TRACKS 15–4170

Tools Needed		A	B	C
1P3490	Press Arrangement	1		1
1P3484	Pin Adapter	1		
3S6224	Pump Group	1	1	1
7S9540	Hydraulic Puller		1	
2S8229	Bushing Adapter			1

1. Remove the three track shoes over the area of the track that has damage. Remove the track. See, SEPARATION OF TRACKS. Put both ends of the track on 6 in. (15.2 cm) wood blocks.

CAUTION: As the track assembly is disassembled, do not cause damage to the parts. Put all of the parts in a position so the ends of the bushings, the thrust rings, pins and seals can not be damaged.

2. Push the track pin part of the way out of the track assembly with tooling (A).
3. Check the track pin for a groove (wear step) caused by wear. If the track pin does not have a groove (wear step), remove it all of the way out of the track assembly. If the track pin has a groove (wear step), push the track pin out 2/3 of its length.

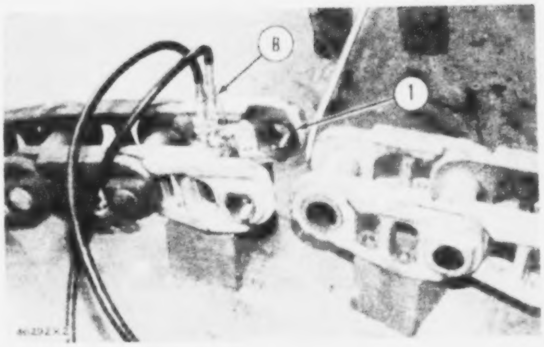
CAUTION: Do not remove the track pin all of the way. Damage to the pin bore and link will be the result.

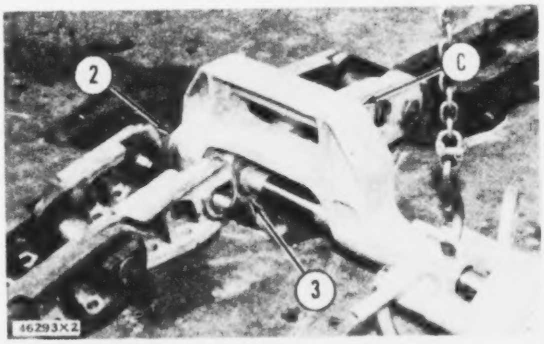
4. Remove tooling (A). Make a separation of the track pin with a cutting torch. Hit the short end of the track pin with a hammer until it is inside the bushing.
5. Remove the next track pin.
6. Put tooling (B) between the track links as shown. Push the links away from each other enough to make a separation of the track chain.

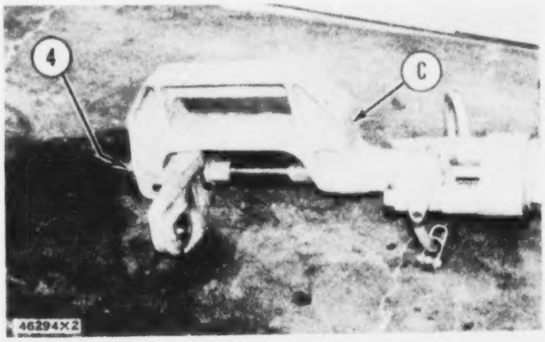
CAUTION: Use shim stock to protect the face of the seals when the track chain is pulled apart.

7. Remove thrust rings (1) from the links.
8. Remove the link, bushing (2) and link (3) with tooling (C).
9. Remove bushing (4) from the link with tooling (C).
10. Remove the seals from the links.

NOTE: If either seal or bushing has damage, use new parts for replacement. Do not use parts from another track assembly.

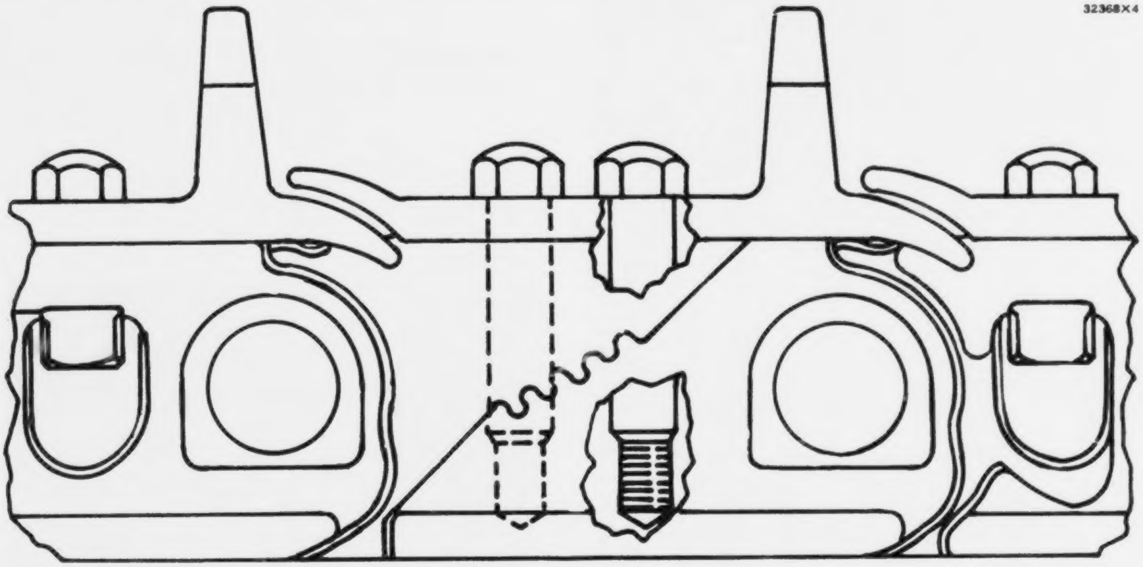




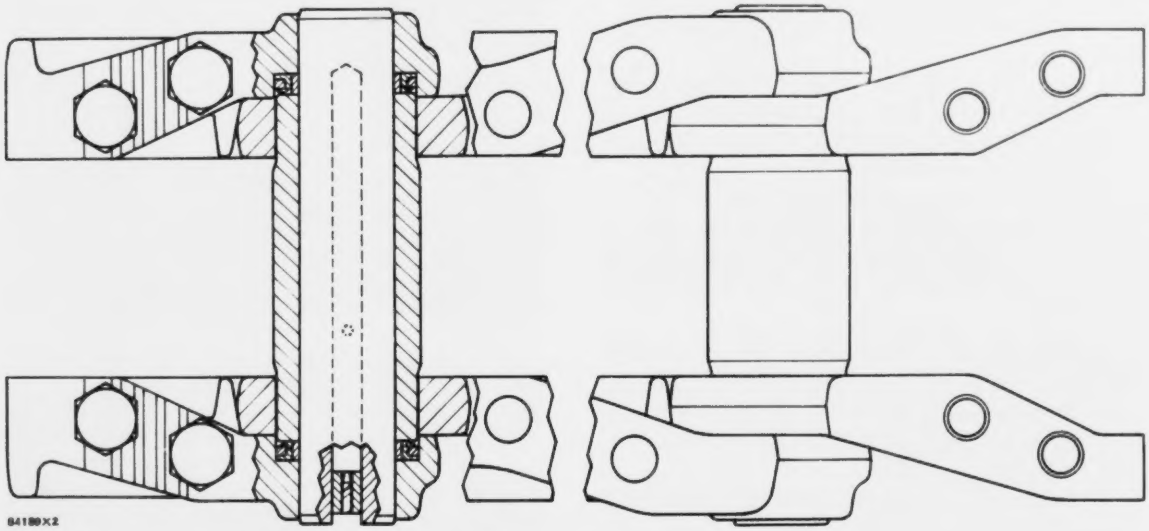


TRACKS

MASTER LINK AND MASTER SHOE



SEALED AND LUBRICATED TRACK ASSEMBLY

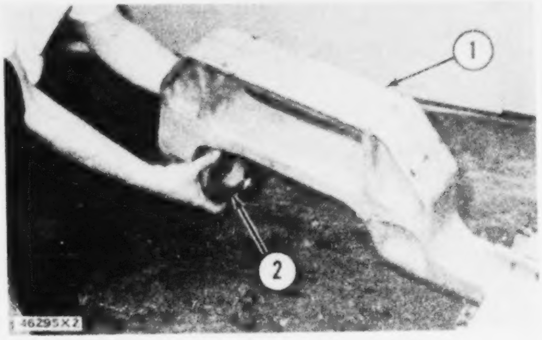


TRACKS

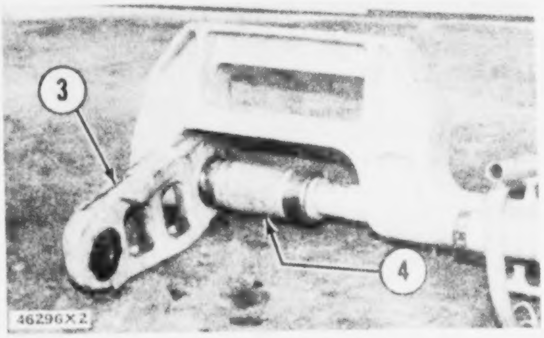
ASSEMBLE TRACKS 16–4170

Tools Needed		A	B	C	D
1P3490	Press Arrangement	1			
3S6224	Pump Group	1		1	
1P3484	Pin Adapter	1			
5P1725	Plug Installer		1		
7F9540	Hydraulic Puller			1	
5P2387	Pump Group				1

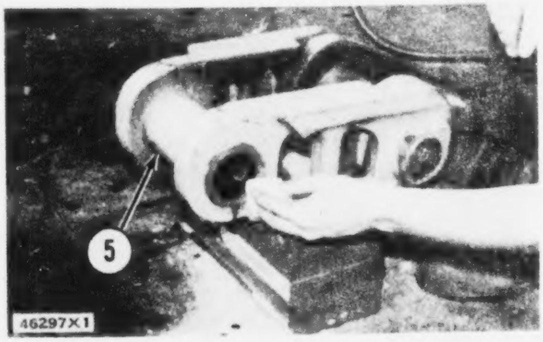
NOTE: Check all of the parts of the track assembly for wear and damage. Make sure the parts are clean and dry. Check the thrust rings for wear. New thrust rings are .437 ± .002 in. (11.1 ± 0.05 mm) thick.



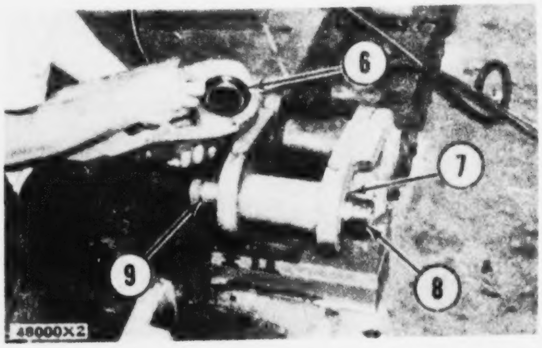
1. Put 1P3484 Pin Adapter (2) from tooling (A) in the frame (1) of the press arrangement with the counterbore toward the ram as shown.



2. Push bushing (4) into link (3) with tooling (A). Push the bushing until it makes contact with the pin adapter. The bushing must be .045 ± .005 in. (1.14 ± 0.13 mm) from the outer surface of the link.

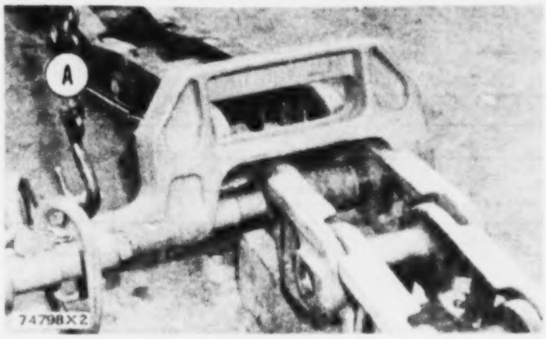


3. Clean both ends of bushing (5) until they are clean and dry. Put clean SAE 90 oil on both ends of the bushing.
4. Put pilot pin (9) in the bushing with the tapered end of the pin as shown.
5. Install thrust rings (7) and (8).
6. Install seals (6).
7. Make sure the seals and thrust rings are clean and dry. Put clean SAE 90 oil on the lip of the seal and the ends of the bushing.



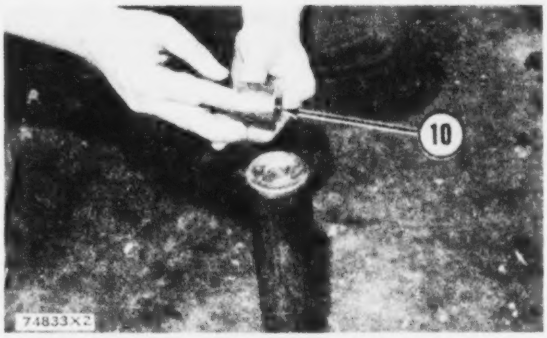
TRACKS

8. Install the links in the bushings with tooling (A).

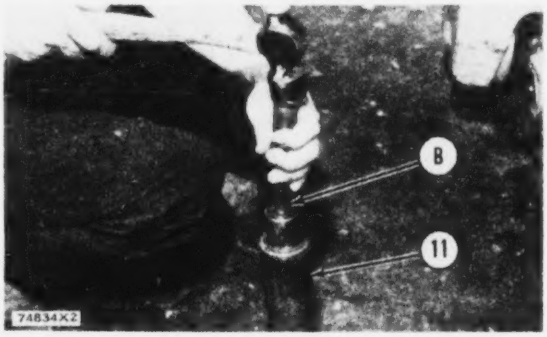


9. If a new track pin is used, put clean SAE 90 oil on the rubber stopper (10). Put the rubber stopper in tool (B).

10. If lubrication tooling is available, the pins do not have to be filled with oil at this time. If lubrication tooling is not available and the rubber stopper is closed, use a punch and push the small plug which is in the center of the rubber stopper into the drilled passage of the pin. Put masking tape over the hole in the side of the pin. Put clean SAE 90 oil in the hole of the rubber stopper with an oil can.

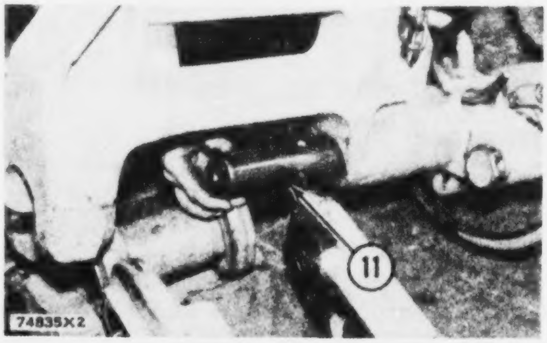


11. Install the rubber stopper in pin (11) with tool (B).



12. Put track pin (11) in tooling (A) with the oil hole up as shown. Remove the masking tape from the oil hole.

CAUTION: To prevent damage to the thrust rings, install tooling (A) so that the track pin will push against the large diameter of the pilot pin.

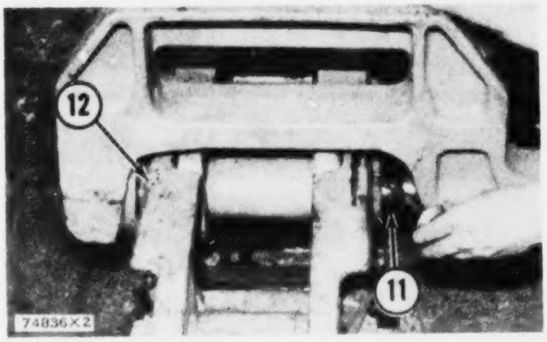


13. Push the track pins into the links until .75 in. (19.05 mm) of the pin is shown. Remove the pilot pin from the press arrangement.

TRACKS

14. Put 7M7260 Liquid Gasket on pin (11) and in the pin bore of link (12).

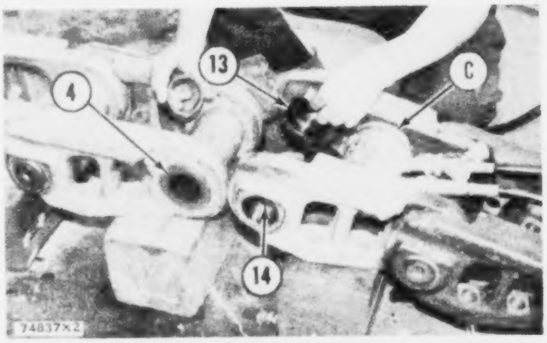
15. Push pin (11) in to the track assembly all of the way. Remove tooling (A).



16. Put tooling (C) between the links as shown. Push the links apart far enough to let the links and bushings go together.

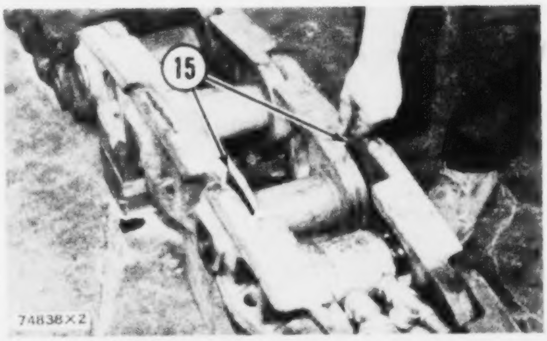
17. Make sure both ends of bushing (4), seals (13) and thrust rings (14) are clean and free of dirt and foreign material. Put clean SAE 90 oil on the seals (13) and the ends of bushing (4). Install thrust rings (14).

18. Put shim stock (15) between the bushings and links to protect the face of the seals from damage. Move the links and pins together. Remove the shim stock and tooling (C).

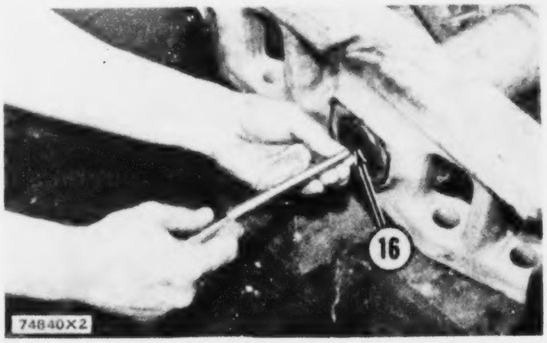


19. Install the pilot pin to keep the links, bushings and thrust rings in alignment.

20. Install the track pin. Follow Steps 12 through 15.



21. If the tracks pins were not filled with SAE 90 oil during assembly, fill the track pins as follows:
    a) Push the plug into the rubber stopper in the drilled passage of the track pin.
    b) Use tool (D) to fill the pins with oil.
    c) Install plug (16).



22. Install the track. See, CONNECTION OF TRACKS.

23. Install the three shoes on the track assembly. Install the bolts that hold them in position. Tighten the bolts to a torque of 250 ± 50 lb.ft. (34.6 ± 6.9 mkg). Tighten the bolts 120° more.

FRONT IDLERS

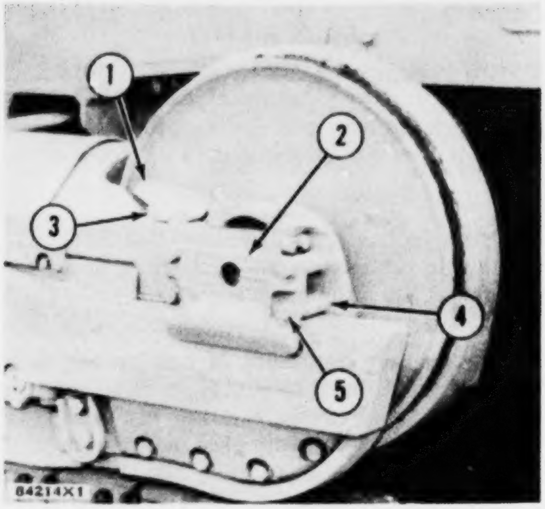
REMOVE FRONT IDLERS 11–4159

start by:
  a) separation of track

1. Remove bolts (3) and guard (1) from each side of the idler.

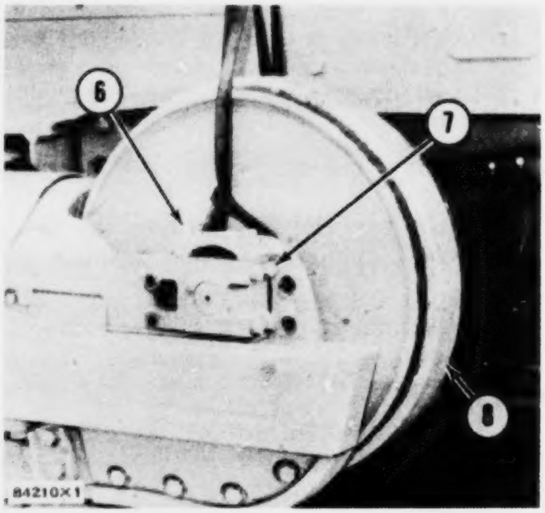
2. Remove bolts (5), spacers (4), shims, and guide (2) from each side of the idler.

NOTE: Keep the shims with their respective guides to prevent mixing at assembly.



3. Remove the strips from behind the collars of the idler.

4. Fasten a hoist to the idler. Remove bolt (6) from each side of the idler.



5. Remove bolts (7) from each side of the idler.

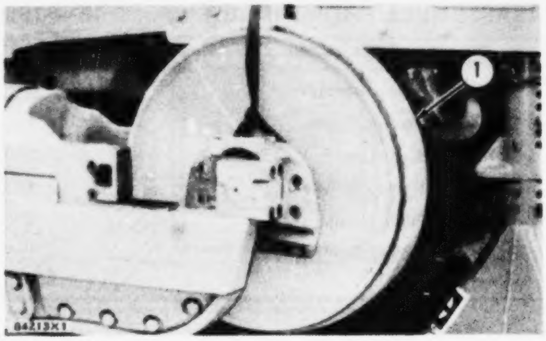
6. Move the idler forward until the collars are free of the track roller frame.

7. Remove the front idler (8). Weight is 750 lb. (340 kg).

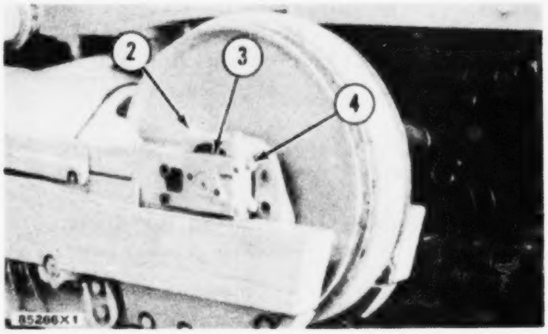
FRONT IDLERS

INSTALL FRONT IDLERS 12–4159

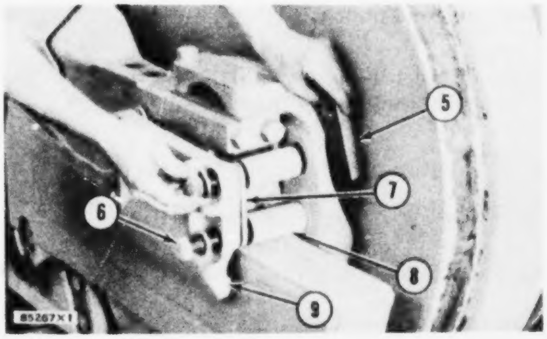
1. Fasten a hoist to the front idler (1). Put the idler in position on the track roller frame.



2. Install bolts (4) on each side of the idler.

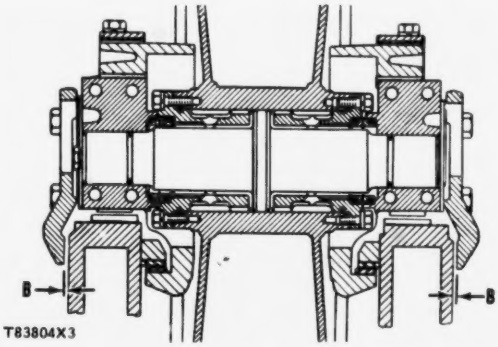


3. Install bolt (2) on each side of the idler. Shims (3) are to make the shaft parallel to the roller shafts and to keep the clearance between the yoke and plate assemblies at .045 ± .015 in. (1.14 ± 0.38 mm). Tighten bolts (2) to a torque of 350 ± 35 lb.ft. (48.4 ± 4.8 mkg).



4. Put guide (9) in position on each side of the idler. Install spacers (8), shims (7), bolts (6), and strips (5) on each side of the idler. Tighten bolts (6) to a torque of 350 ± 35 lb.ft. (48.4 ± 4.8 mkg).

5. Put the guards in position on each side of the idler. Install the bolts that hold the guards.



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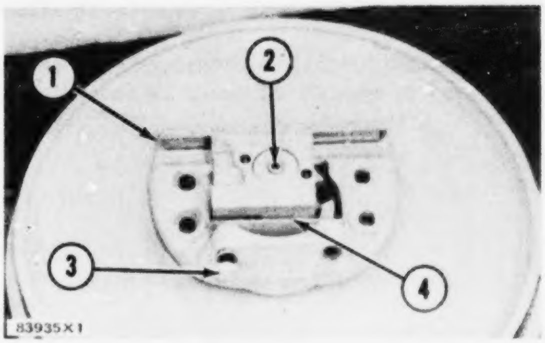
NOTE: Shims (7) are to keep dimension (B) a distance of .032 ± .016 in. (0.81 ± 0.41 mm)

FRONT IDLERS

DISASSEMBLE FRONT IDLER 15–4159

Tools Needed		A
8B7548	Puller Assembly	1
8S6586	Forcing Screw	1
8B7561	Step Plate	1
7F9540	Hydraulic Puller	1
9S5800	Pump Group	1
FT570	Puller Plate	1
1A1135	Bolt	2

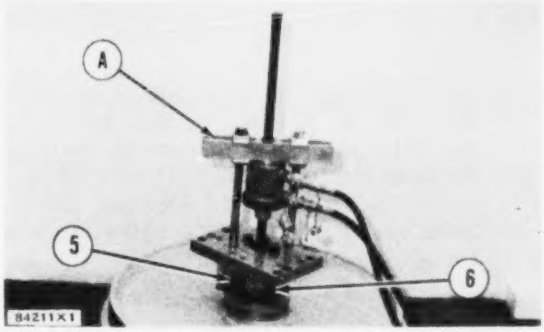
start by:
a) remove front idler



1. Remove plug (2). Remove oil from idler. Install plug to prevent dirt from getting into the shaft.

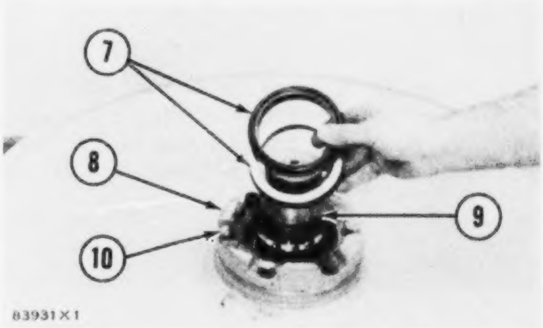
2. Remove bolt (3). Remove collar (1) and shims (4).

CAUTION: Put identification on the shims as to their location on the idler to prevent mixing at assembly.



3. Remove bolt (5). Remove the lock that holds the bearing on the idler with a hammer and punch.

4. Install tooling (A) on the bearing (6). Remove the bearing from the idler shaft.

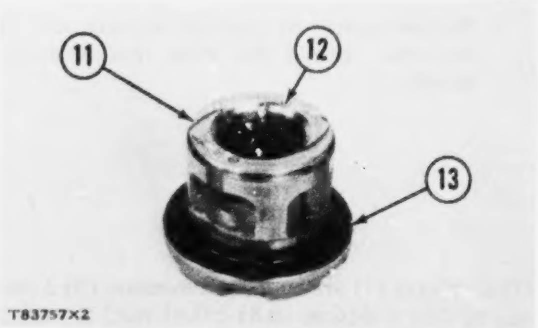


5. Remove two Duo-Cone seals (7).

CAUTION: Put identification on the seals as to their location on the idler to prevent mixing at assembly.

6. Remove bolts (10).

7. Follow the procedure in Steps 2 through 6 and remove the collar, shims, bearing, and Duo-Cone seals from the opposite side of the idler.



8. Remove the bushing assemblies (8) and shaft (9) with a press.

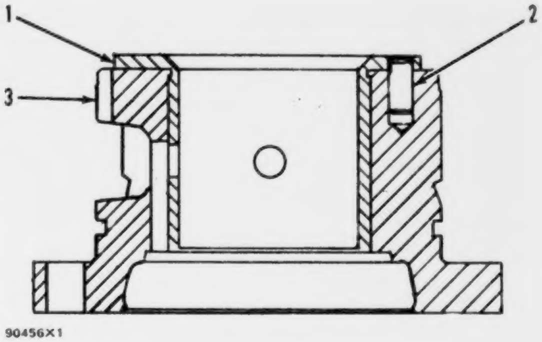
9. Remove the bearings (11) from bushings (13) with a press. Cut pins (12) even with the face of the bushing. Make the face of the bushing smooth with a file.

FRONT IDLERS

ASSEMBLE FRONT IDLERS 16–4159

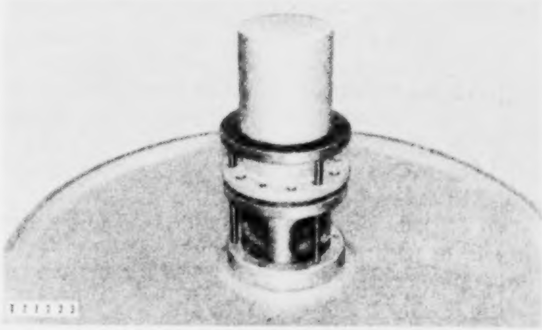
Tools Needed		A	B	C
FT578	Bushing Alignment Tool	1		
5M2160	Installer Assembly		1	
8S2328	Dial Test Indicator Group			1

1. Put the oil holes in bearing (1) in alignment with the oil holes in bushing (3). Install the bearing in the bushing with a press. Drill two .297 in. (7.54 mm) diameter holes 180° apart through the bearing and into the bushing. Drill the holes .75 in. (19.0 mm) deep.



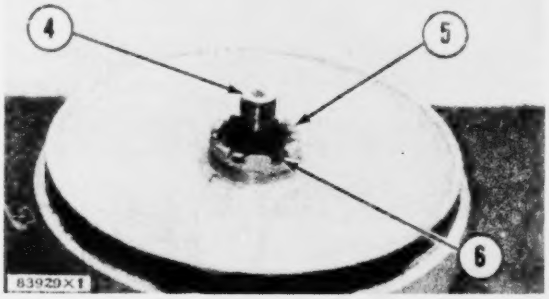
CAUTION: Do not drill the holes through the lubrication grooves in the face of the bearing flange.

2. Install two new pins (2) even with the outside face of the bearing.



3. Install the bearing in the other bushing following the same procedure as in Steps 1 and 2.

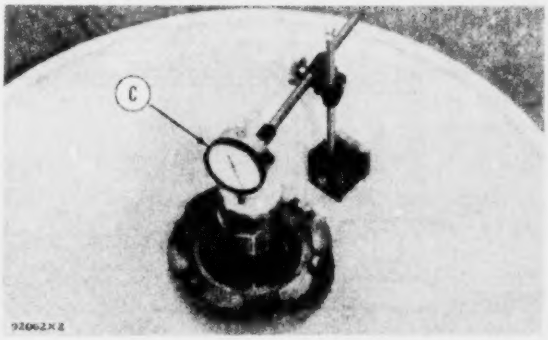
4. Install new O-ring seals on the bushings. Put lubricant on the O-ring seals. Put 9M3710 Anti-Seize Compound on the surfaces of the bushings that make contact with the inner diameter of the roller.



5. Install bushing (3) in the roller with tool (A) and a press. Install the bolts that hold it.

NOTE: Check the diameter of shaft (4). Check the amount the shaft is bent. Check the clearance between the shaft and its bearings. See FRONT IDLER AND RECOIL SPRING in POWER TRAIN SPECIFICATIONS.

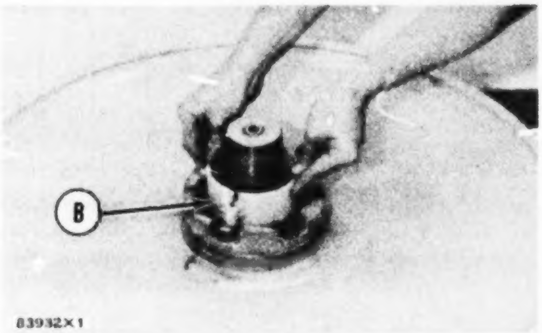
6. Install the shaft in the bushing and roller. Install the bushing (5) in the roller with tool (A) and a press. Install bolts (6) that hold it.



7. Install tool group (C) and make a check of the end play for the shaft. The end clearance must be .031 in. (0.79 mm) maximum or .009 in. (0.23 mm) minimum.

FRONT IDLERS

8. Make sure the Duo-Cone seals (12) and (13), and all metal surfaces that are in contact with the seals are clean and dry. Install the seals in the bushings and bearings with tool (B). Put lubricant on O-ring seals (19) and (20). Put a light amount of oil on the metal surfaces of the seals that make contact with each other.



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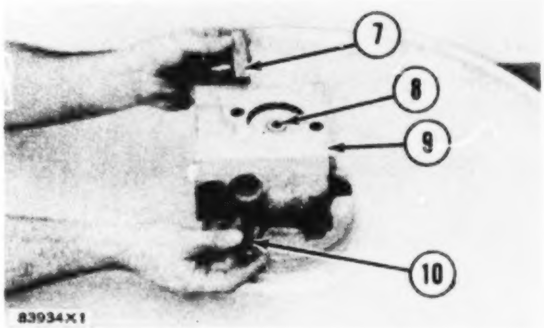
9. Put 9M3710 Anti-Seize Compound on the inner surfaces of the bearings. Install the bearings (9) on their respective ends of the shaft. Put the holes in the bearings in alignment with the grooves in the shaft. Put 9M3710 Anti-Seize Compound on the lock (7) and install it in the hole in the bearing. Install bolt (10) in the lock. Tighten the bolt to a torque of 65 lb.ft. (9.0 mkg). Hit the lock with a hammer and punch. Tighten the bolt again to a torque of 75 ± 10 lb.ft. (10.4 ± 1.4 mkg).



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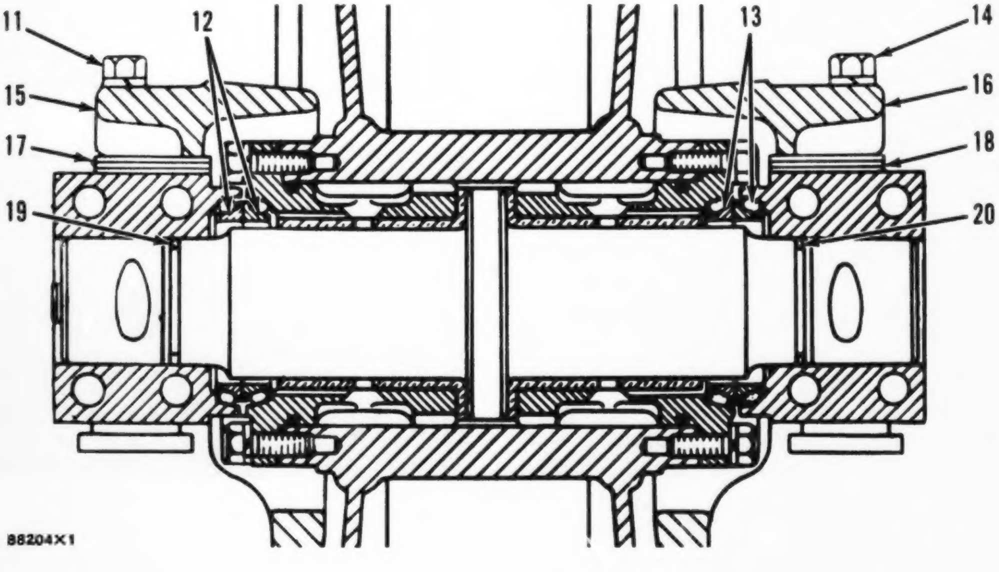
10. Install collars (15) and (16) over the bearings. Install shims (17) and (18) between their respective collars and bearings. Install bolts (11) and (14).

11. Put the front idler in a horizontal position. Remove plug (8). Fill the front idler with oil. See FRONT IDLER LUBRICATION in SYSTEMS OPERATION. Install the plug. Tighten the plug to a torque of 125 ± 15 lb.ft. (17.3 ± 2.1 mkg).

end by:
a) install front idler



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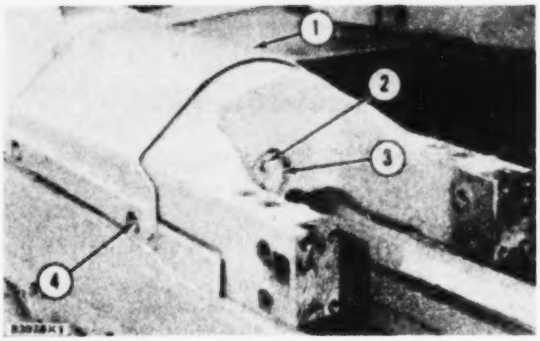
YOKE ASSEMBLIES

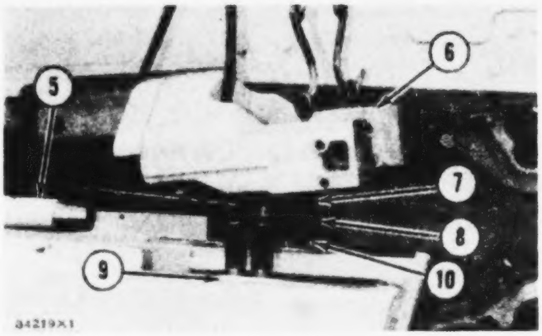
REMOVE YOKE ASSEMBLIES 11–6153

start by:
  a) remove front idlers

1. Remove bolts (4) and guard (1).



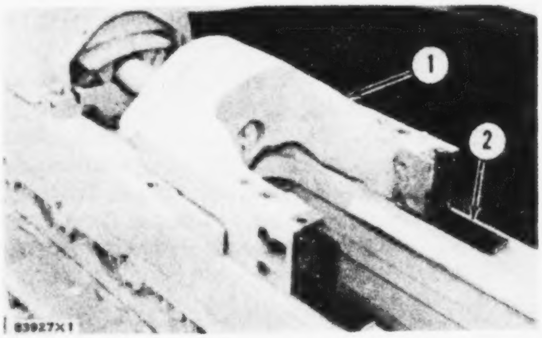
2. Remove bolts (2) and retainer (3). Hit recoil rod (5) at the rear of the yoke assembly to loosen the taper on the rod from the yoke.



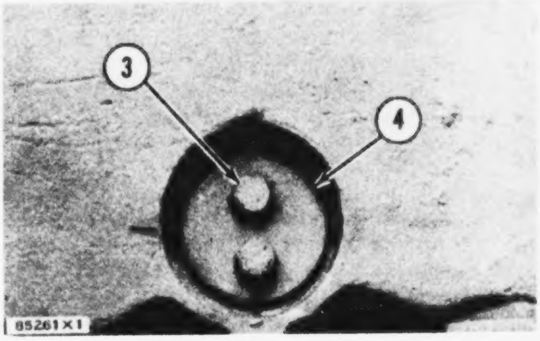
3. Fasten a hoist to the yoke assembly. Move the yoke assembly (6) forward and free of the track frame. Remove four plates (7), spring assemblies (8), plates (10), and two plate assemblies (9).

INSTALL YOKE ASSEMBLIES 12–6153

1. Put the plate assemblies (2) in position on the track frame. Fasten a hoist on the yoke assemblies (1) and put it in position over the plate assemblies. Install the four plates, spring assemblies, and plates in the yoke assembly.



2. Lower the yoke assembly on the track. Move the yoke assembly to the rear until the recoil rod is in alignment with its hole in the yoke assembly. Put the retainer (4) in position on the yoke assembly with the notch of the retainer in alignment with the groove in the yoke assembly. Install bolts (3).



3. Install the track guard and the bolts that hold it.

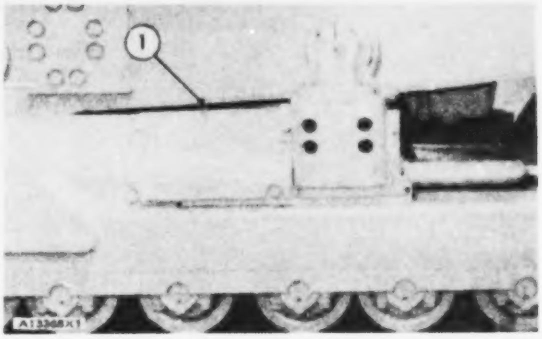
end by:
  a) install front idlers

PISTONS AND CYLINDERS

REMOVE PISTONS AND CYLINDERS 11–4157

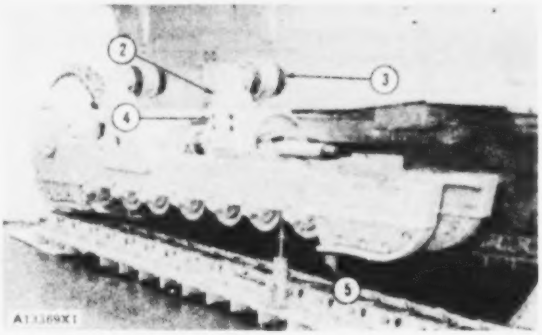
start by:
  a) remove yoke assemblies

1. Remove guard (1) from over the track adjuster.



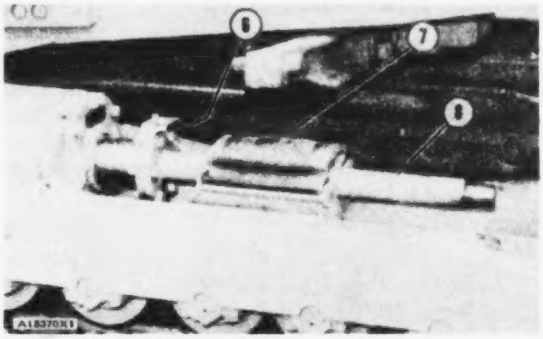
2. Put two hydraulic jacks (5) under the track roller frame as shown. Lift the track roller frame until the weight is off of the equalizer bar.

3. Fasten a hoist to track carrier roller (3). Remove four bolts (2). Remove the track carrier roller. Weight of the track carrier roller is 130 lb. (59 kg).



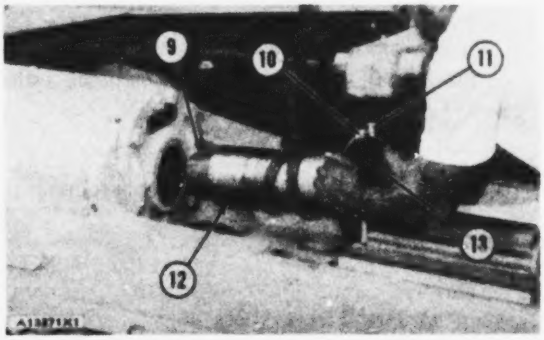
4. Lower the track roller frame until support (4) can be removed. Remove the six bolts that hold the support in position. Remove the support. Weight of the support is 146 lb. (66 kg).

5. Remove plate (7) from over the rod. Remove bolts (6) that hold the rod to the cylinder. Fasten a hoist to the rod. Remove the rod. Weight of the rod (8) is 100 lb. (45.4 kg).



6. Fasten a hoist to the cylinder. Remove piston and cylinder (12) as a unit. Weight of the unit is 70 lb. (32 kg).

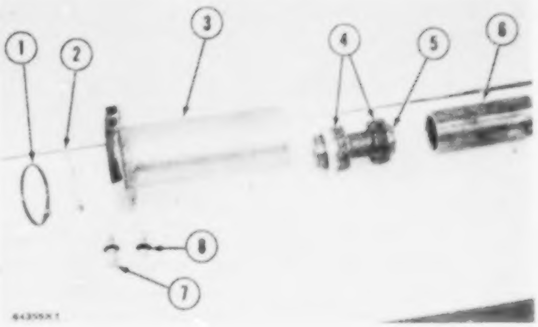
7. Remove sleeve (9), piston assembly, ring, seal (13), fill valve (10) and relief valve (11) from the cylinder. Check the rings, washer and seals in the piston assembly for damage. If the parts have damage, use new parts for replacement.



PISTONS AND CYLINDERS

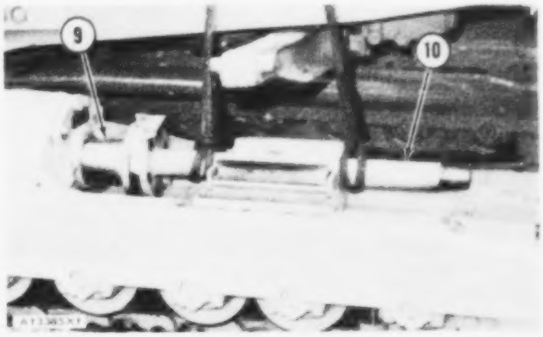
INSTALL PISTONS AND CYLINDERS 12–4157

1. Install fill valve (8) and relief valve (7) in cylinder (3). Tighten the valves to a torque of 25 ± 3 lb.ft. (3.5 ± 0.7 mkg). Install the piston (5) in the front end of the cylinder. Install sleeve (6) in the opposite end of the cylinder. Install ring (2) and seal (1) in the cylinder.



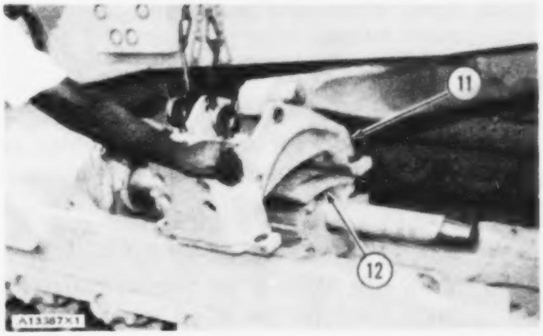
NOTE: If new rings (4) are installed on piston (5), assemble the rings so the angle cuts are 180° apart.

2. Fasten a hoist to the piston and cylinder assembly (9). Install it in the cover of the recoil spring.



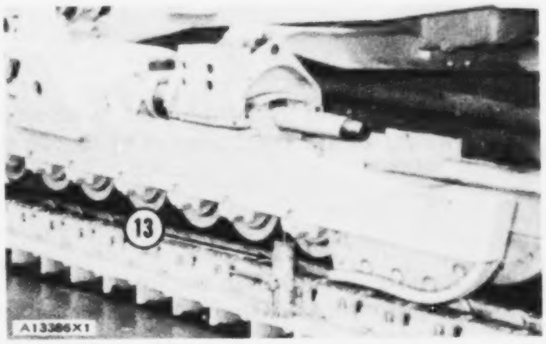
3. Fasten a hoist to rod (10). Put the rod in position against the cylinder. Slide the lower plate of the suspension assembly under the rod as shown. Make sure the holes in the rod are in alignment with the holes in the cylinder. Install the bolts and nuts that hold the rod and cylinder together.

4. Put plate (12) in position over the rod.



5. Fasten a hoist to support (11). Put the support in position over the suspension assembly. Install the six bolts that hold it.

6. Lift the track roller frame with hydraulic jacks (13) until the sleeve that holds the track roller frame on the equalizer bar can be installed. Install the sleeve, bolt and nut.



7. Fasten a hoist to the track carrier roller. Put the track carrier roller in position on the support. Install the four bolts that hold it.

8. Install the guard over the track adjuster.

   end by:
   a) install yoke assemblies

RECOIL SPRINGS

REMOVE RECOIL SPRINGS 11–4158

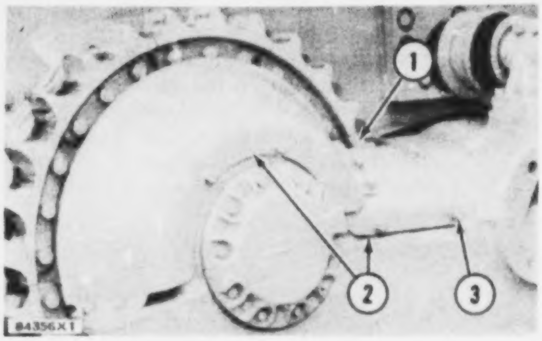
Tools Needed		A
1P3075	Puller Group	1

start by:
  a) remove pistons and cylinders

⚠ WARNING: Do not remove the front cover for the recoil springs until Step 4 is completed. If the front pilot for the recoil springs is broken, the following procedure must not be used. See RECOIL SPRINGS (WITH BROKEN PILOTS) for the correct procedure.

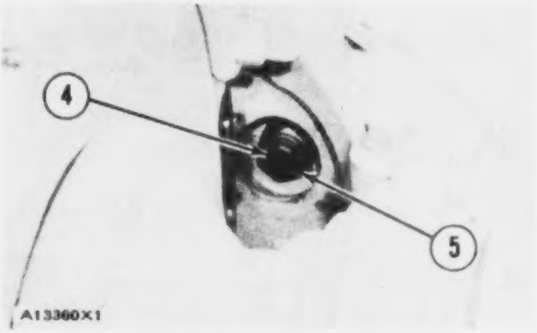
1. Remove bolts (3) and guards (2).

2. Remove the bolts, nuts, and sprocket segment (1).



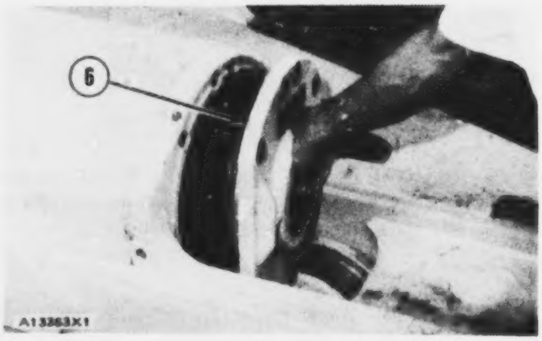
3. Remove the bolts and the rear cover for the recoil springs.

4. Remove bolt (4) and washer. Tighten nut (5) until the springs are under compression.

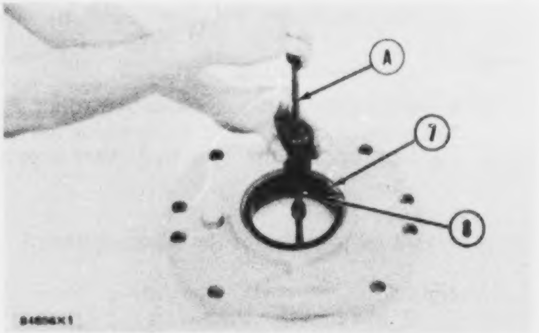


5. Make sure there is no tension against the front cover for the recoil springs by loosening its bolts a little at a time. Remove the bolts.

6. Remove front cover (6) for the recoil spring. Weight of the front cover is 45 lb. (20 kg).



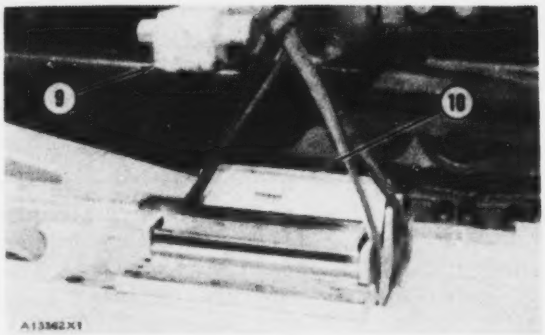
7. Remove seal (7) from the front cover with tool group (A). Remove the snap ring and bearing (8).



RECOIL SPRINGS

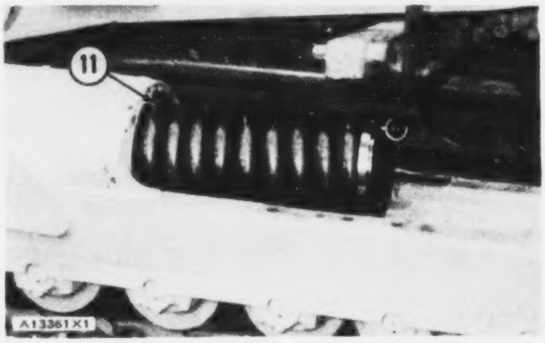
8. Fasten a hoist to the suspension assembly (10) and remove it. Weight is 140 lb. (64 kg).

9. Lift the front of the tractor until the bottom of the equalizer bar (9) is approximately 10 in. (25.4 cm) above the top of the track frame.



10. Install a 5/8"–11NC forged eyebolt into the recoil spring pilot and fasten a hoist to it. Remove the recoil springs (11) by sliding it forward under the equalizer bar. Weight is 625 lb. (283 kg).

NOTE: Measure the length of the recoil springs under compression if they are to be disassembled. This same length will be needed for installation.



RECOIL SPRINGS

INSTALL RECOIL SPRINGS 12–4158

Tools Needed		A	B
1P532	Handle	1	1
1P525	Drive Plate	1	
1P527	Drive Plate		1

1. Fasten a hoist to the recoil spring. Put the recoil springs (1) in position on the track frame. Slide the springs to the rear under the equalizer bar into the recoil spring housing.

2. Install the snap ring in the front cover. Install the bearing in the cover with tooling (A). Make sure the bearing is even with the snap ring. Install the seal in the front cover with tooling (B).

3. Put the front cover (2) in position on the recoil spring housing. Make sure the drain plug is at the bottom. Install the bolts that hold the cover to the recoil spring housing.

4. Loosen nut (3) until the rear face of the nut is .062 in. (1.57 mm) past the end of the bolt. Install the bolt and washer that hold the nut in position.

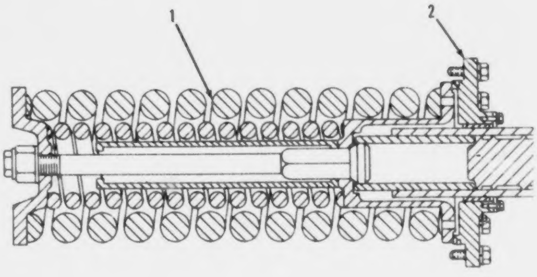
5. Put plate (6) in position on the rear of the recoil spring housing. Install bolts (5) that hold it.

6. Put sprocket segment (7) in position on the sprocket hub. Install the bolts and nuts (4) that hold it. Install the head of the bolt against the hub. Tighten the nuts to a torque of 250 ± 50 lb.ft. (34.6 ± 6.9 mkg). Tighten the nuts another 1/3 (120°) turn. The minimum torque of the nuts is 650 lb.ft. (89.9 mkg) after the 1/3 (120°) turn.

7. Put the guards in position on the track frame. Install the bolts that hold the guards.

8. Fasten a hoist to the suspension assembly and put it in position on the front of the track frame.

end by:
   a) install pistons and cylinders



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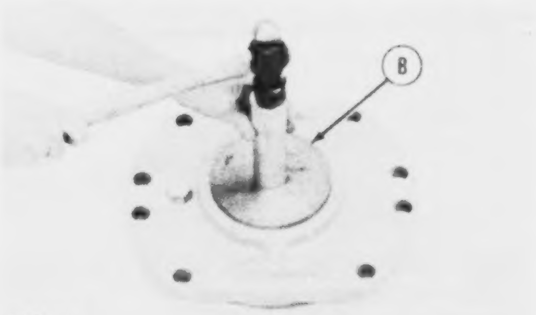

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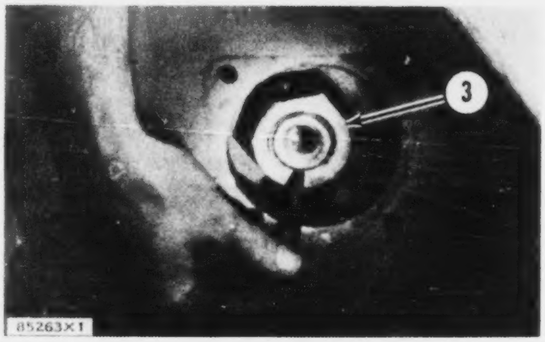

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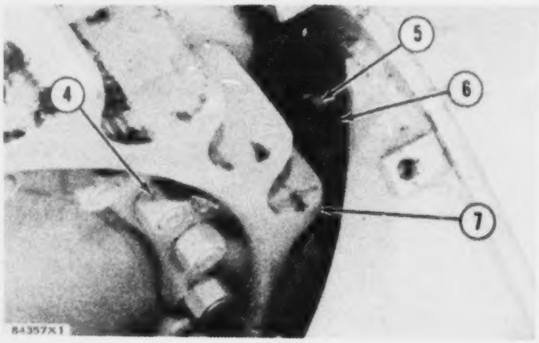

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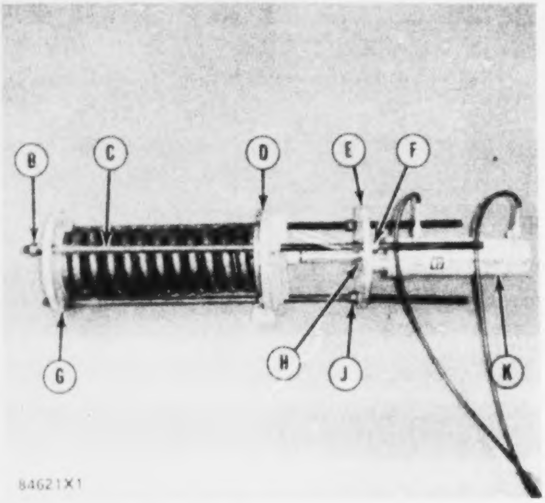
RECOIL SPRINGS

DISASSEMBLE RECOIL SPRINGS 15–4158

Tools Needed		A
FT577	Spring Compressor	1
3K9770	Nut	12
8S7172	Cylinder Group	1
1J2921	Bolt	2

start by:
  a) remove recoil springs

⚠ WARNING: The recoil springs are assembled under a force of several tons. This force is released against legs (C) during disassembly. Caution must be used to make sure the correct tooling is used and the correct procedure is followed.



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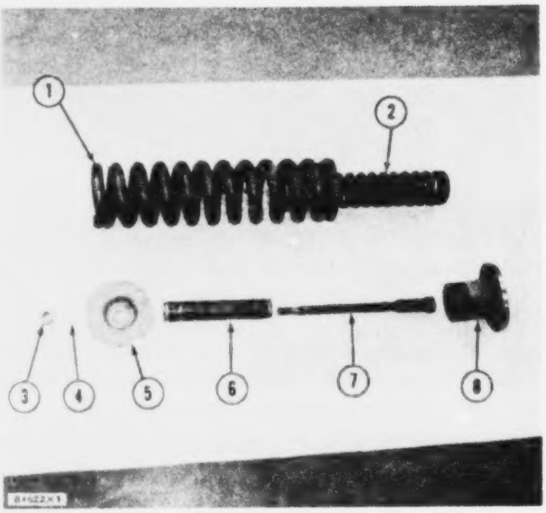
1. Fasten a hoist to the recoil springs. Install the springs into tooling (A) as follows:
   - a) Put plate (D) in position on the recoil springs. Install legs (C) through the holes in plate (D).
   - b) Put plate (G) in position on the rear of the springs and install nuts (B). Put the springs so the centers of pilots (5) and (8) are in alignment with the centers of plates (G) and (D), respectively. Tighten nuts (B).
   - c) Make an adjustment to nuts (J) so the distance between plates (G) and (D) is the same on all three legs (C) to prevent twisting of the spring.
   - d) Put cylinder group (K) in position on plate (E). Install two bolts (H) and spacers that hold the cylinder group to plate (E). Put plate (E) in position on legs (C) and install nuts (F).
2. Put the spring under enough compression to remove nut (3) from bolt (7). Turn nuts (J) until they are against plate (E).
3. Release the compression on the spring until plate (D) is against nuts (J).
4. Follow the procedure in Steps 2 and 3 until the spring is no longer under compression.
5. Remove nuts (B) and plate (G). Remove pilot (5). Fasten a hoist to springs (1) and (2). Remove the springs. Weight of spring (1) is 400 lb. (181 kg). Weight of spring (2) is 80 lb. (36 kg). Remove pipe assembly (6). Remove bolt (7) from pilot (8). Weight of pilot (8) is 45 lb. (20 kg).



RECOIL SPRINGS

ASSEMBLE RECOIL SPRINGS 16–4158

	Tools Needed	A
FT577	Spring Compressor	1
3K9770	Nut	12
8S7172	Cylinder Group	1
1J2921	Bolt	2

⚠ WARNING: The recoil springs are assembled under a force of several tons. This force is released against legs (C) during assembly. Caution must be used to make sure the correct tooling is used and the correct procedure is followed.

1. Put 1P2783 oil on the surfaces of all recoil spring components to prevent rust.

2. Assemble the recoil springs in tooling (A) as follows.

   a) Install spring (2) into spring (1). Install bolt (7) into pilot (8). Install pipe assembly (6) on bolt (7) with the large opening toward pilot (8). Install the pipe assembly, bolt, and pilot as a unit into the springs. Install pilot (5) on the end of the springs.

   b) Fasten a hoist to the assembled components. Install the components into tooling (A). Install plate (G) and nuts (B) over legs (C). Put the springs so the centers of pilots (5) and (8) are in alignment with the centers of plates (G) and (D), respectively. Tighten nuts (B).

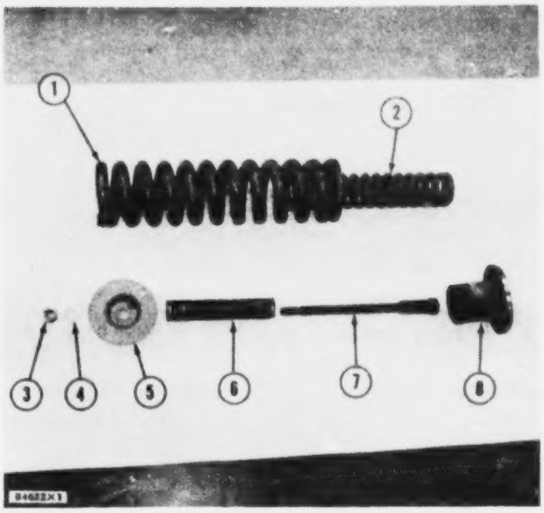
   c) Make sure the distance between plates (G) and (D) is the same for all three legs (C) to prevent twisting of the springs.

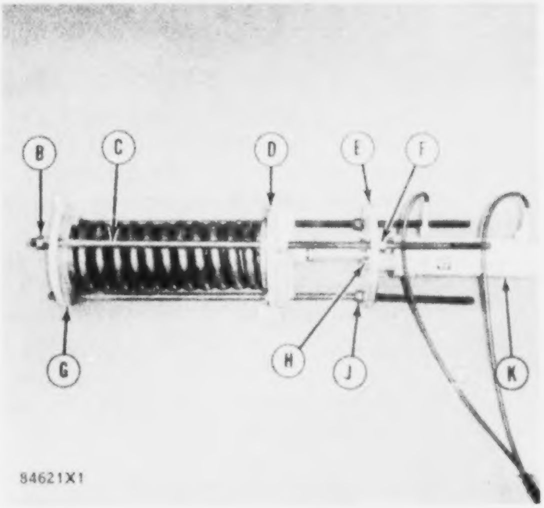
3. Put the springs under compression until the distance between the outer faces of pilots (5) and (8) is 33 in. (83.8 cm). When putting the springs under compression make sure the bolt (5) is in alignment with the hole in pilot (5). Install washer (4) and nut (3) on bolt (7).

4. Release the pressure from the springs. Remove nuts (B) and plate (G). Remove the recoil springs from tooling (A).

   end by:

   a) install recoil springs



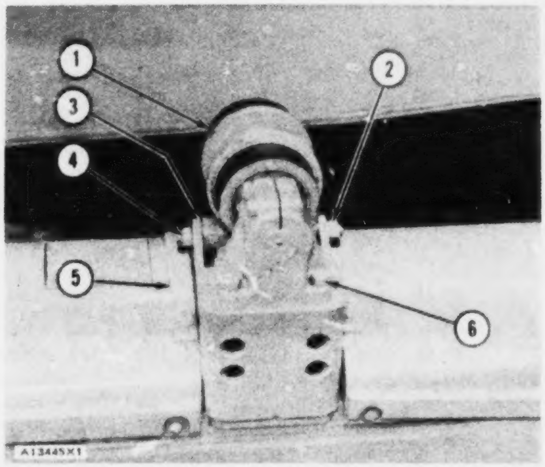


TRACK ROLLER FRAMES

REMOVE TRACK ROLLER FRAMES 11–4151

start by:
a) separation of tracks

1. Make sure the side of the machine from which the track roller frame is removed is lifted 12 in. (30.5 cm). Put supports under the side of the machine to hold it in position.



2. Fasten a hoist to the track carrier roller (1). Remove four bolts (6). Remove the track carrier roller. Weight of the track carrier roller is 130 lb. (59 kg).

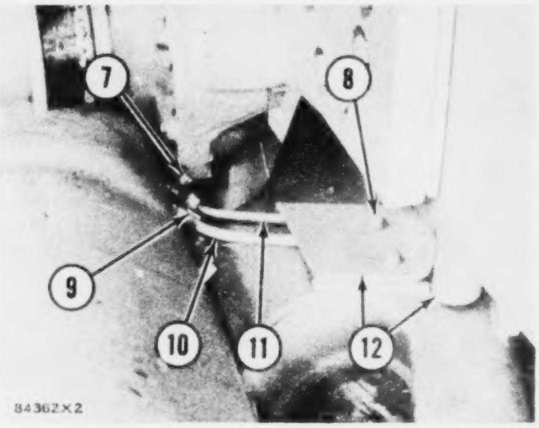
3. Remove strap (5).

4. Fasten a hoist around the front part of the track roller frame between the third and fourth track rollers.

5. Remove nut (2), bolt (4) and sleeve (3).

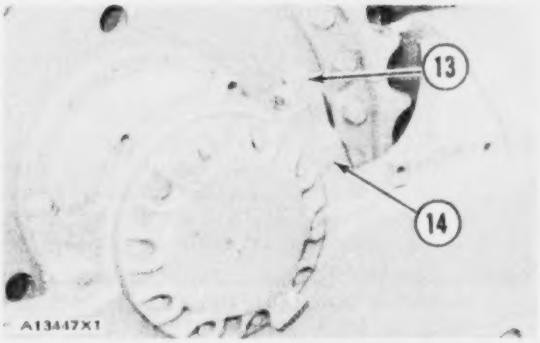
6. Lower the track roller frame until the equalizer bar is out of the support.

⚠ WARNING: Do not remove the hoist from the track roller frame at this time.



7. Remove bolts (8) and guards (12).

8. Remove bolts (7) and plate (9). Move hydraulic lines (10) and (11) out of the way of the track roller frame.



9. Remove the two guards from over the sprocket.

10. Install a 5/8"–11 NC forged eyebolt in one of the rear holes in the track roller frame that holds the guard for the sprocket in position. Use a chain and lift truck that can hold the weight of the rear part of the track roller frame. Weight is 2000 lb. (907 kg). Fasten the chain to the eyebolt.

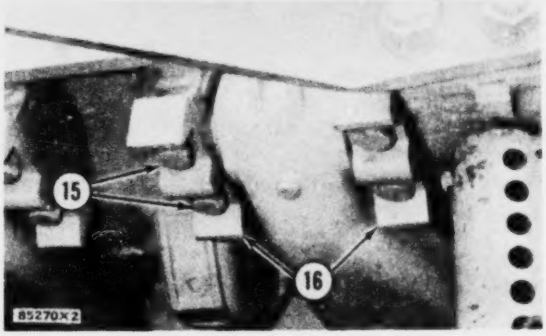
11. Remove four bolts (13) and cap (14) from the track roller frame.

TRACK ROLLER FRAMES

12. Remove bolts (15) and two caps (16) that hold the diagonal brace to the bevel gear case.

13. Lower the rear of the track roller frame until the diagonal brace is clear of the bevel gear case and the track roller frame is free of the sprocket support. Move the track roller frame forward and away from the machine.

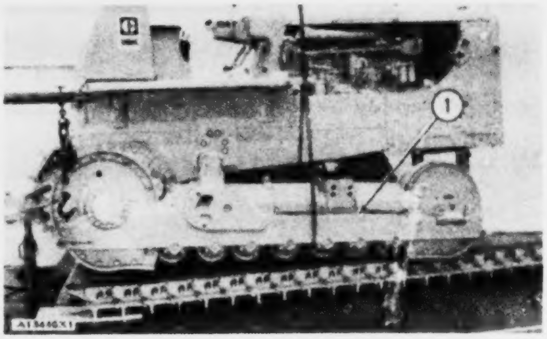
⚠ WARNING: Make sure the track roller frame does not hit the equalizer bar when it is removed. Weight of the track roller frame is 8000 lb. (3629 kg).



INSTALL TRACK ROLLER FRAME 12–4151

1. Fasten a hoist and a chain to the track roller frame (1) as shown. Move the track roller in and to the rear of the machine.

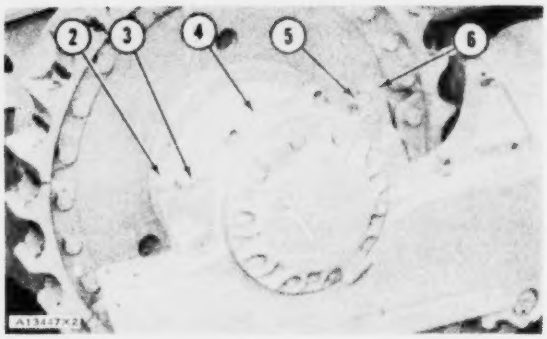
⚠ WARNING: Do not hit the equalizer bar when the track roller frame is put in position.



2. Lift the rear of the track roller frame until the diagonal brace makes contact with the bevel gear case and the outer part of the track roller frame makes contact with the sprocket support.

NOTE: Make sure the diagonal brace is the correct position in the bevel gear case.

3. Install bearing cap (4) and the four bolts that hold it. Do not tighten the bolts.



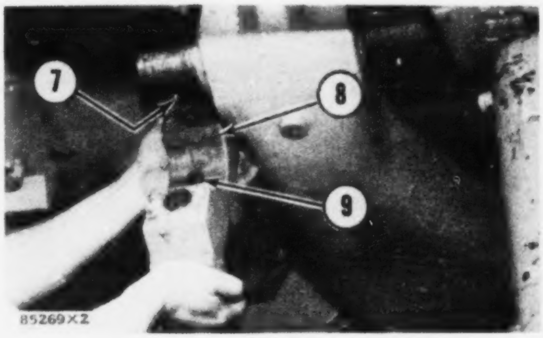
4. Tighten the four bolts to the correct torque as follows:
   a) Tighten bolts (2) and (3) to a torque of 960 ± 80 lb.ft. (132.8 ± 11.1 mkg).
   b) Tighten bolt (5) to a torque of 960 ± 80 lb.ft. (132.8 ± 11.1 mkg). Measure the distance between the cap and track roller frame at bolt (5) with a thickness gauge. Remove bolt (5) and install the correct amount of shims between the cap and the track roller frame.
   c) Install bolts (5) and (6). Tighten the bolts to a torque of 960 ± 80 lb.ft. (132.8 ± 11.1 mkg).

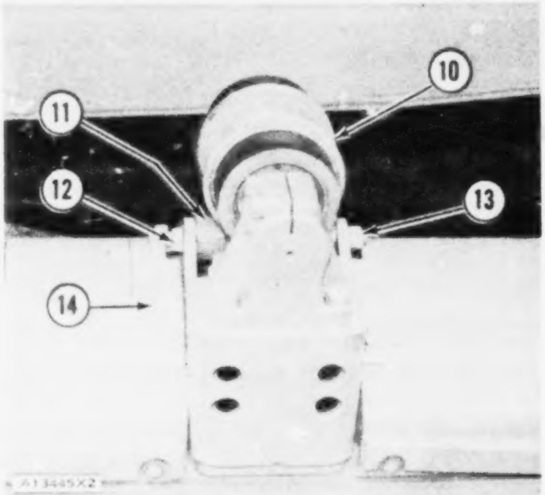
NOTE: On the left side of the machine the bolts in front of the cap are installed and the shims are installed at the rear of the cap.

TRACK ROLLER FRAMES

5. Put cap (8) with dowel (9) in position on the diagonal brace shaft. Make sure the dowel is in alignment with hole (7) in the shaft. Install the two bolts that hold the cap. Install the other cap and two bolts.

NOTE: Only one cap has a dowel. The cap with the dowel must be installed on the end of the diagonal brace shaft that is toward the center of the machine.

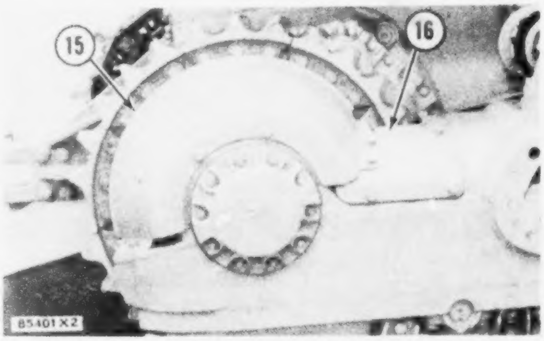




6. Put the two oil lines for the bulldozer tilt cylinder in position on the track roller frame. Install the two bolts and plate that hold the lines in position. Install the two guards for the oil lines.

7. Lift the front of the track roller frame with the hoist until the end of the equalizer bar is in position in the support for the track carrier roller.

8. Install sleeve (11), bolt (12) and nut (13). Install plate (14).



9. Install track carrier roller (10).

10. Install guards (15) and (16) over the sprocket.

end by:
a) connection of tracks

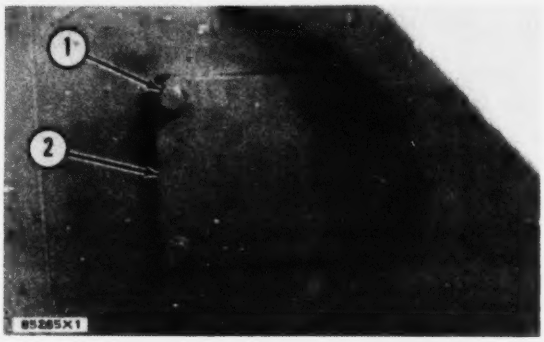
RECOIL SPRINGS (WITH BROKEN PILOTS)

REMOVE RECOIL SPRINGS (WITH BROKEN PILOTS) 11–4158

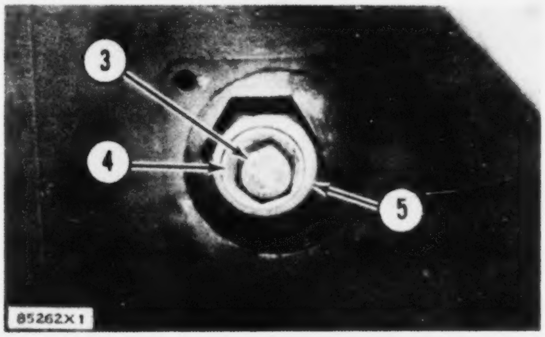
	Tools Needed	A
FT576	Tool Group	1
5F9885	Adapter	1
5F9888	Adapter	1
5F9892	Pin	1
8S7172	Cylinder Group	1
3S6224	Pump Group	1
3H466	Nut	3
3H467	Washer	3

start by:
a) remove track roller frames
b) remove pistons and cylinders

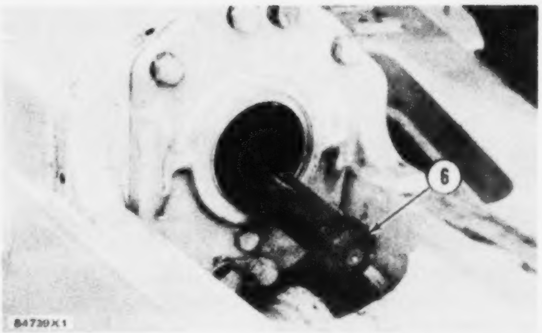
⚠ WARNING: The recoil springs are under several tons of force. Do not remove cover (15) until the force is controlled by tooling (A).



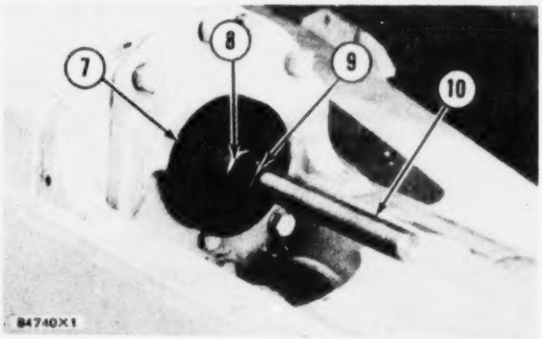
1. Remove bolts (1) and cover (2).



2. Remove bolt (3), washer (4), and nut (5).



3. Remove bolt (6) from the front pilot.



4. Install tooling (A) on the recoil springs as follows:

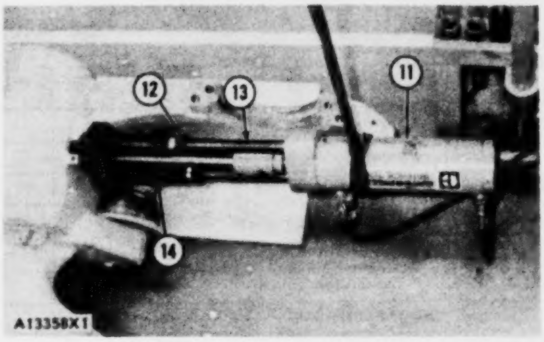
   a) Install bolt (10) through the front cover and springs. Install plate (7), washer (8), and nut (9) on the bolt.

RECOIL SPRINGS (WITH BROKEN PILOTS)

b) Install the other components for tooling (A) as shown.

c) Make an adjustment to nuts (12) so the ends of the studs (13) are against the bottom of fixture (14).

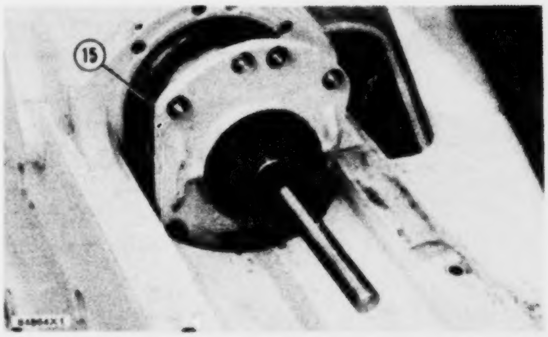
d) Make an adjustment to bolt (10) so the travel that cylinder group (11) can make is approximately 11 in. (27.9 cm).



5. Put enough force on the front cover to hold the springs when the bolts are removed.

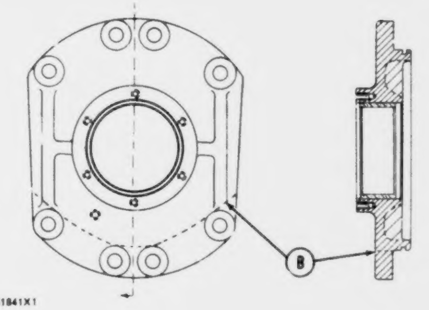
⚠ WARNING: Do not put more than 50 ton (45 t) of force on bolt (10).

6. Remove the bolts that hold the front cover to the recoil spring housing.



7. Release the compression from the recoil springs until front cover (15) moves approximately 6 in. (15.2 cm).

8. Cut the cover along the dotted line (B) as shown to let the cover clear the track frame. Completely release all the force from the recoil springs.



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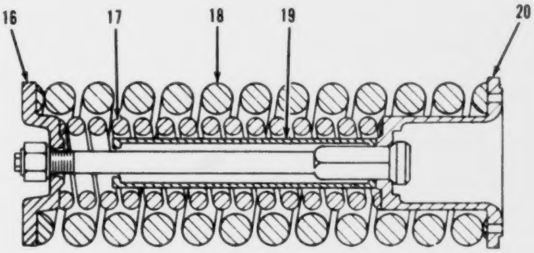
9. Remove the nut, washer, plate, and the front cover.

10. If the front pilot (20) is broken, remove it. If the rear pilot (16) is broken, remove the front pilot, pipe assembly (19), small spring (17), large spring (18), and rear pilot.



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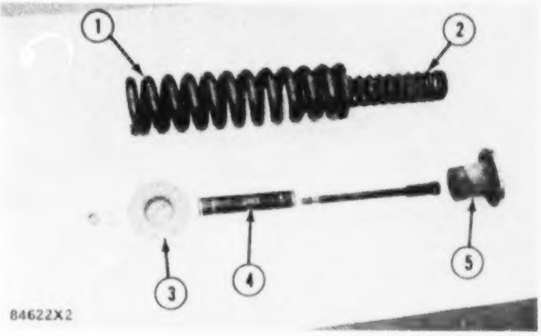
RECOIL SPRINGS (WITH BROKEN PILOTS)

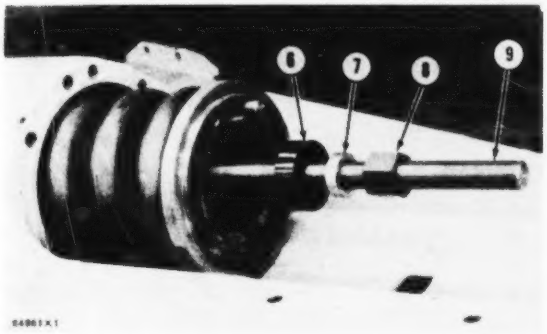
INSTALL RECOIL SPRINGS (WITH BROKEN PILOTS) 12–4158

Tools Needed		A	B	C
FT576	Tool Group	1		
5F9885	Adapter	1		
5F9888	Adapter	1		
5F9892	Pin	1		
8S7172	Cylinder Group	1		
3S6224	Pump Group	1		
3H466	Nut	3		
3H467	Washer	3		
1P532	Handle		1	1
1P527	Drive Plate		1	
1P525	Drive Plate			1



84622X2

1. Install new rear pilot (3) if needed. Install large spring (1). Install small spring (2) in the large spring. Install pipe assembly (4) with the small hole toward the rear pilot. Install new front pilot (5) if needed.



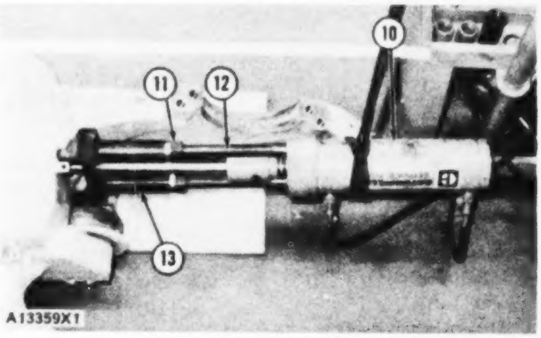
84861X1

2. Install tooling (A) on the recoil springs as follows:

   a) Install bolt (9) through the recoil springs. Install plate (6), washer (7), and nut (8).

   b) Install the other components for tooling (A) as shown. Make an adjustment to nuts (11) so the ends of the studs (12) are against the bottom of fixture (13).

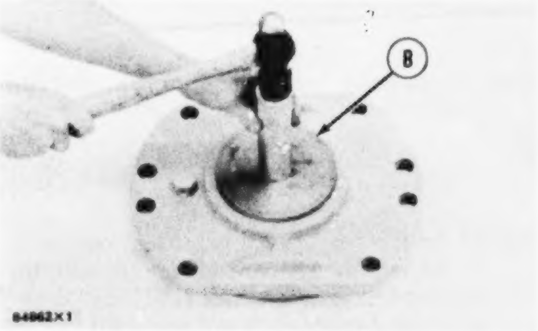
   c) Move the rod of the cylinder group (10) until it is fully extended. Tighten nut (8) until plate (6) is against the front pilot.



A13359X1

3. Put the recoil springs under compression until the front face of the pilot is approximately 1 in. (2.54 cm) past the front face of the recoil spring housing.

⚠ WARNING: Do not put more than 50 ton (45 t) of force on bolt (9).

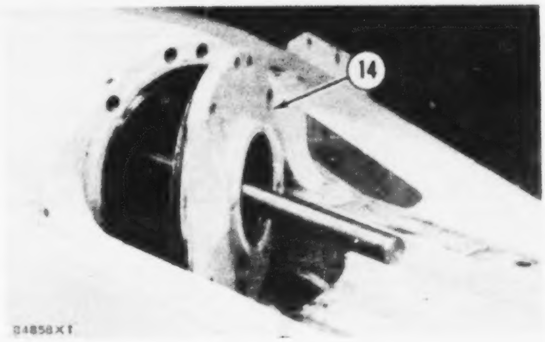


84862X1

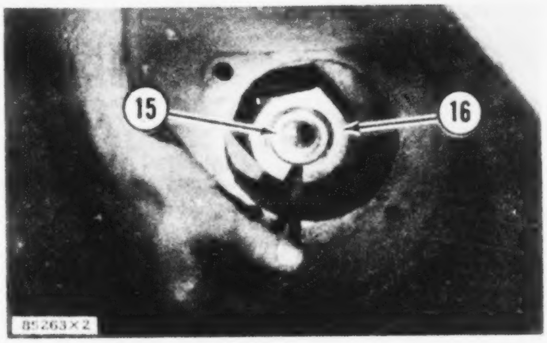
4. Install the snap ring in a new front cover. Install the bearing in the front cover with tooling (C). Install the seal in the front cover with tooling (B).

RECOIL SPRINGS (WITH BROKEN PILOTS)

5. Put front cover (14) in position on the recoil spring housing and install the bolts that hold it. Remove tooling (A).



6. Install bolt (15) through the recoil springs. Install washer and nut (16) on the bolt. Tighten the nut until its rear face is extended .062 in. (1.57 mm) past the rear face of bolt (15). Install the washer and bolt that hold the nut in position.



7. Put the rear cover for the recoil springs in position on the recoil spring housing and install the bolts that hold it.

end by:
  a) install pistons and cylinders
  b) install track roller frames

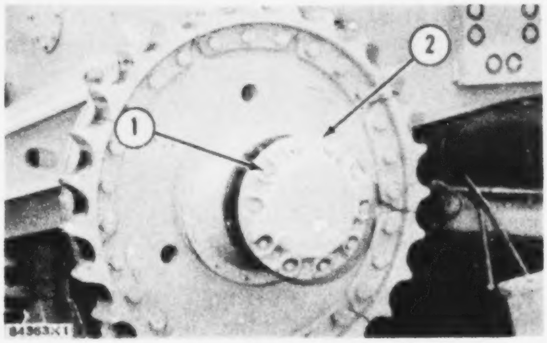
SPROCKETS

REMOVE SPROCKETS 11–4164

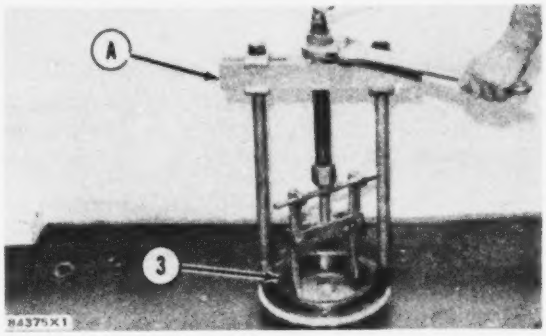
Tools Needed		A	B	C	D	E
1H3107	Bearing Puller Assembly	1				
1H3108	Legs	2				
1H3112	Puller	1				
8F2239	Wrench	1				
8B7548	Puller Assembly		1			
8H684	Ratchet Box Wrench		1			
8B7560	Step Plate		1			
1M6760	Spanner Wrench			1		
9S8901	Cylinder Group				1	1
7M9792	Pin				2	1
7M9793	Adapter				2	1
7M9794	Adapter				1	1
5F9306	Arm				3	3
6H4158	Pin				6	6
5P2180	Puller				1	
5P972	Adapter				1	
S1587	Bolt				10	
1P5585	Adapter				1	1
6H1625	Adapter					3
8F6220	Nut					3
9S5800	Pump Group				1	1

start by:
a) remove track roller frames

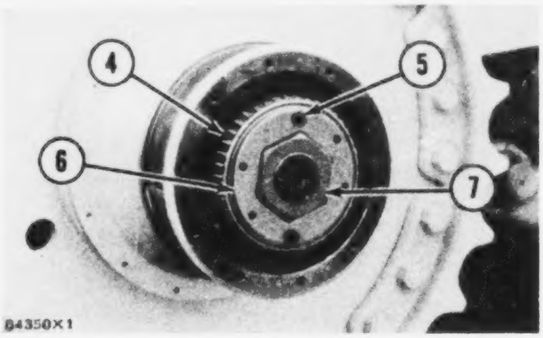
1. Remove the oil from the final drive case.



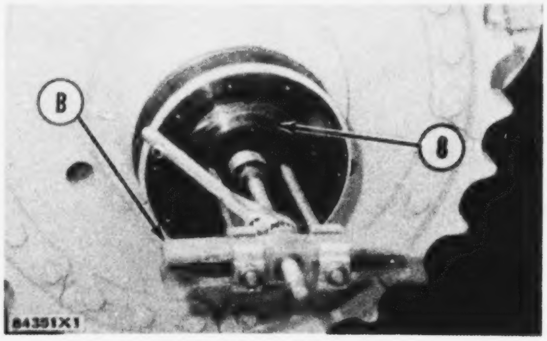
2. Remove bolts (1) that hold the cap to the support. Install two 1/2”–13NC forcing screws into the cap. Remove cap (2) and its shims.



3. Remove the bearing race (3) from the cap with tooling (A).



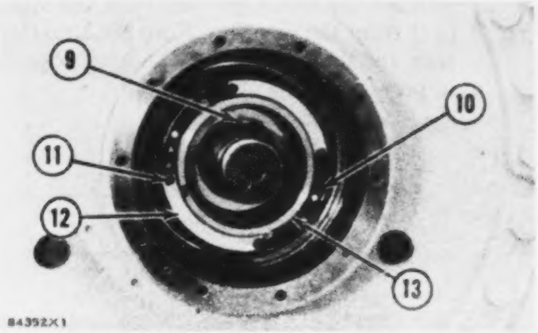
4. Remove bolts (5) and lock (6). Remove nut (7) from the shaft. Remove bearing cone (4) from bearing cage.



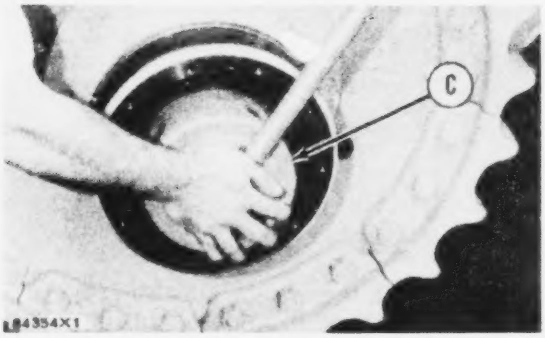
5. Remove bearing cage (8) with tooling (B). Remove the bearing cup from the bearing cage with a hammer and punch.

SPROCKETS

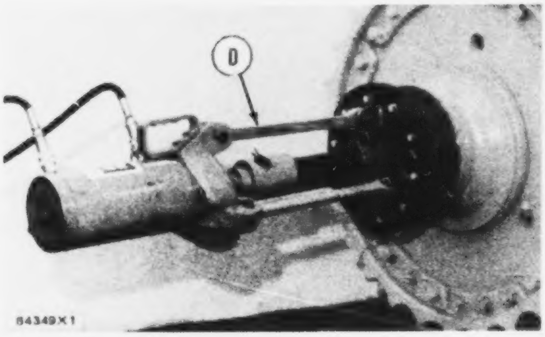
6. Remove key (9) from the shaft. Remove bolts (11), locks (12), and a lock (10).


9
10
11
12
13
84352X1

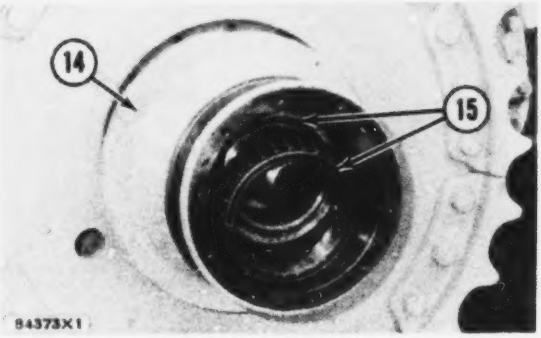
7. Remove nut (13) and spacer with tool (C).



8. Loosen the support and bearing cones from the sprocket shaft with tooling (D).

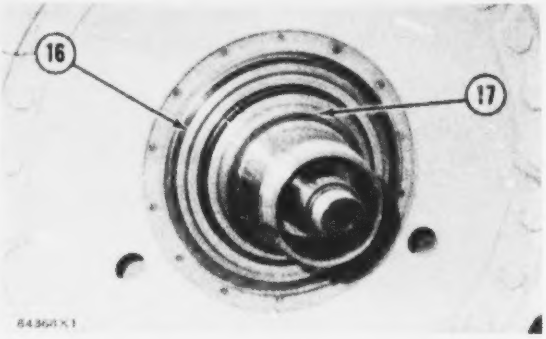


9. Remove two bearing cones (15) from the shaft. Fasten a hoist to the support (14) and remove it. Weight is 120 lb. (54 kg). Remove the Duo-Cone seal from the support. Remove the bearing cup from the support with a hammer and punch.

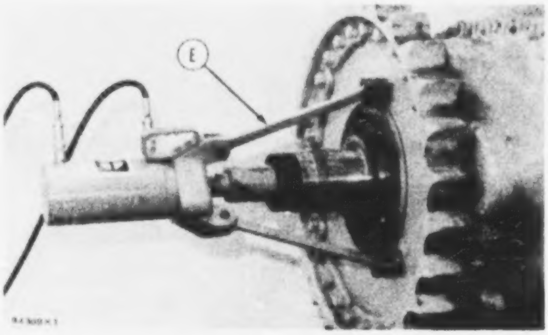

14
15
84373X1

SPROCKETS

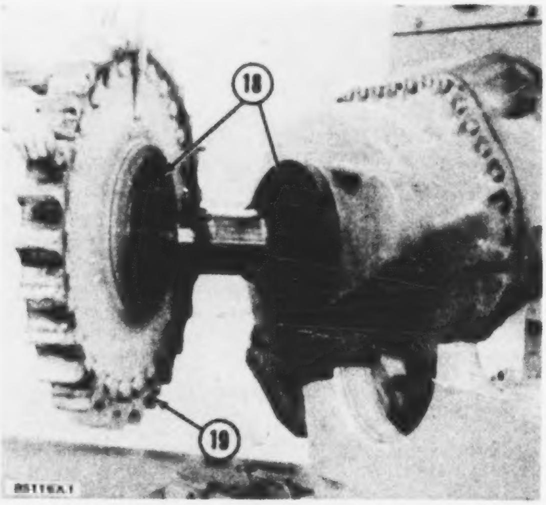
10. Remove the Duo-Cone seal (16) and spacer (17) from the sprocket. Keep the Duo-Cone seals for the sprocket and support together to prevent mixing at assembly.



11. Loosen the sprocket from the shaft with tooling (E).



12. Fasten a hoist to the sprocket (19) and remove it. Weight is 700 lb. (318 kg).

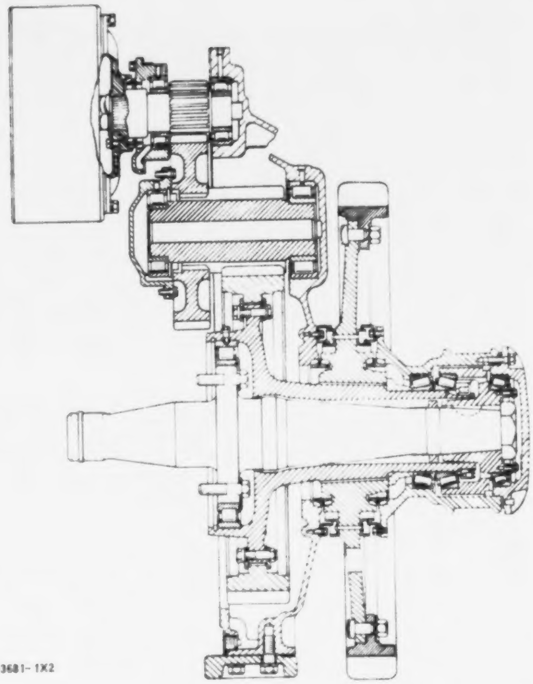


13. Remove the Duo-Cone seals (18) from the sprocket and final drive case. Keep the seals together to prevent mixing at assembly.

SPROCKETS

INSTALL SPROCKETS 12–4164

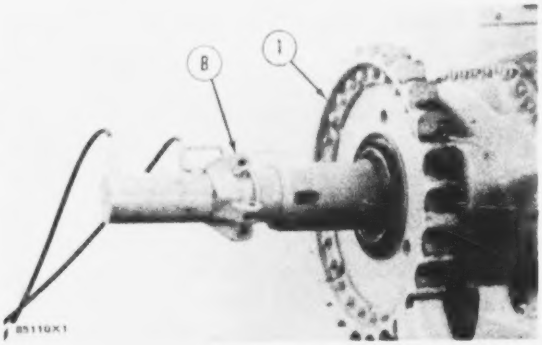
Tools Needed		A	B	C	D	E
8M7912	Seal Installer	1				
9S8901	Cylinder Group		1			
9H3992	Head		1			
1S6645	Sleeve Assembly		1			
7M9774	Coupling		1	1		
7M9772	Pin		1	1		
8M4843	Adapter		1			
9S8900	Cylinder Group			1		
7F5283	Head			1		
1M6756	Sleeve			1		
7M9773	Adapter			1		
1M6760	Spanner Wrench				1	
FT520	Adapter					1
9S5800	Cylinder Group		1	1		

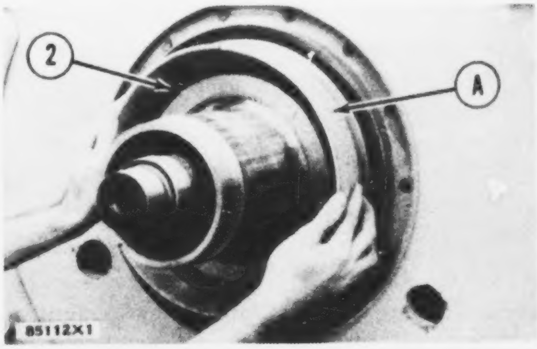


1. Make sure the Duo-Cone seals for the final drive case and sprocket are clean and dry. Make sure all metal surfaces that the seals make contact with are clean and dry. Install the Duo-Cone seals in the final drive case and inner side of the sprocket with tool (A). Put a light amount of oil on the metal surfaces of the seals that make contact with each other.
2. Fasten a hoist to the sprocket (1) and put it in position on the final drive hub. Make sure the splines of the sprocket and the hub are in alignment. Push the sprocket on the hub as far as possible by hand.

CAUTION: Make sure the splines of the hub and sprocket are clean and dry.

3. Install tooling (B) on the sprocket shaft.
4. Push the sprocket on the final drive hub with a force of 60 to 65 ton (54 to 59 t). Remove tooling (B). Measure the distance from the front face of the sprocket to the front of the splines of the final drive hub. The distance must be .25 ± .06 in. (6.4 ± 1.5 mm).
5. Make sure the Duo-Cone seals for the sprocket and support are clean and dry. Make sure all metal surfaces with which the seals make contact are clean and dry. Install the Duo-Cone seals (2) in the sprocket and support with tool (A). Put a light amount of oil on the metal surfaces of the seals that make contact with each other.

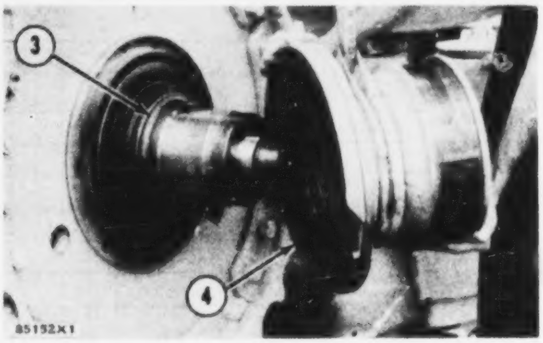




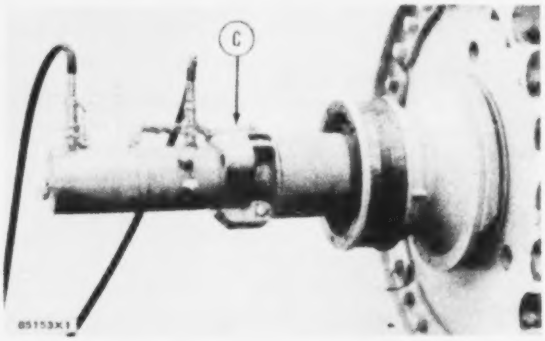
SPROCKETS

6. Install spacer (3) on the hub.

7. Lower the temperature of the bearing cup for the support and install it in the support. Fasten a hoist to the support (4) and put it in position on the hub.

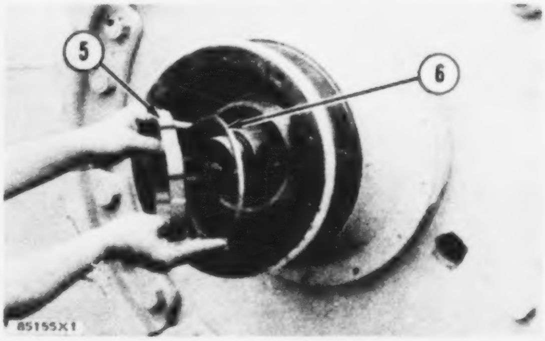


8. Heat the two bearing cones for the support in oil to a maximum temperature of 275°F (135°C). Install one of the bearing cones on the hub with a hammer and punch far enough to put it in alignment with the hub.



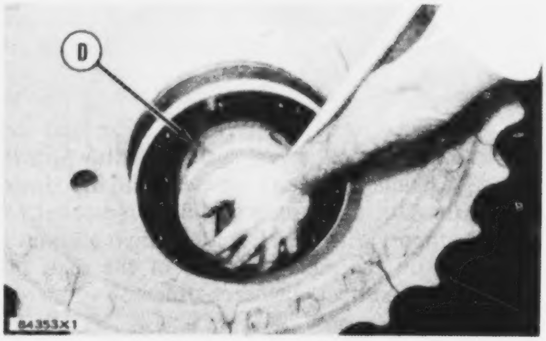
9. Install tooling (C) on the sprocket shaft.

10. Put enough force on the cylinder group to push the bearing cone on the hub until it is against the spacer. Remove tooling (C).

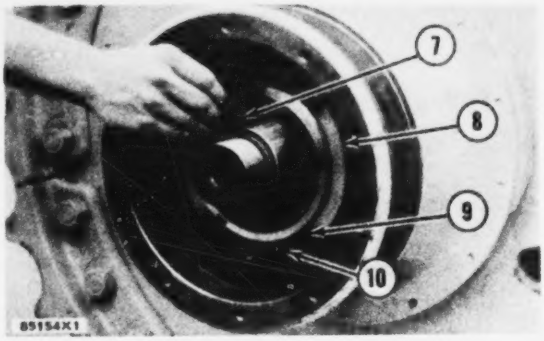


11. Install the other bearing cone on the hub. Install spacer (6) and nut (5) on the hub.

12. Tighten the nut with tool (D) until the second bearing cone is against the first bearing cone.

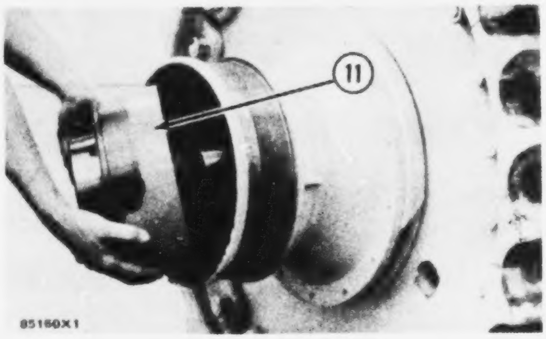


SPROCKETS



13. Tighten or loosen nut (5) until the holes in the nut and lock (8) are in alignment. Install locks (10) and bolts (9). Install key (7) in the sprocket shaft.

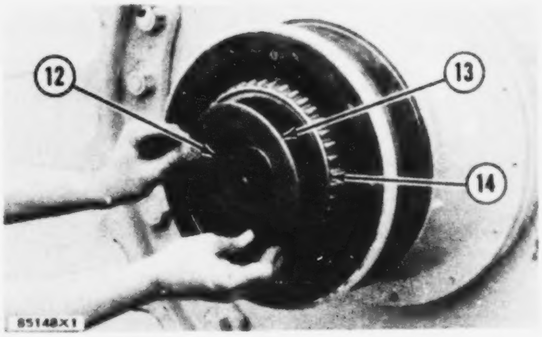
14. Lower the temperature of the bearing cup for the bearing cage and install it in the cage. Put the groove in the bearing cage in alignment with the key on the sprocket shaft. Install the bearing cage (11) on the shaft.



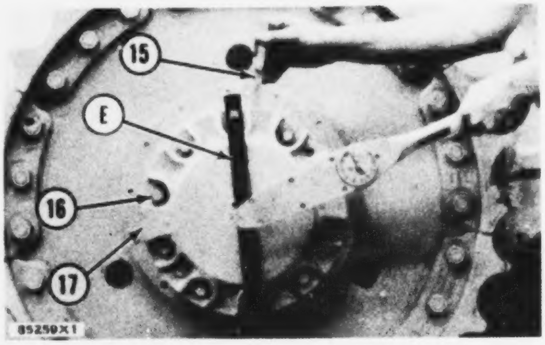
15. Install nut (12) on the shaft. Tighten the nut to a torque of 1350 ± 135 lb.ft. (186.7 ± 18.7 mkg).

16. Install bearing cone (14) on the bearing cage.

17. Tighten or loosen nut (12) until the holes in lock (13) and the bearing cage are in alignment when the lock is installed. Install the bolts that hold the lock.



18. Install cap (17) on the support without the cork gasket and shims. Install bolts (16). Install tool (E) on the cap. Turn the support four or five revolutions before checking the torque. Put a preload on the bearings by tightening bolts (16) so a torque of 40 to 50 lb.ft. (5.5 to 6.9 mkg) is needed to turn the support. Measure the distance between the front face of the support and rear face of the cap with a feeler gauge (15).



19. Remove the bolts and cap (17). Install the cork gasket on the bearing cage. Install enough shims on the cap to make up the distance measured in Step 18. Put the cap and shims in position on the support. Install the bolts that hold it.

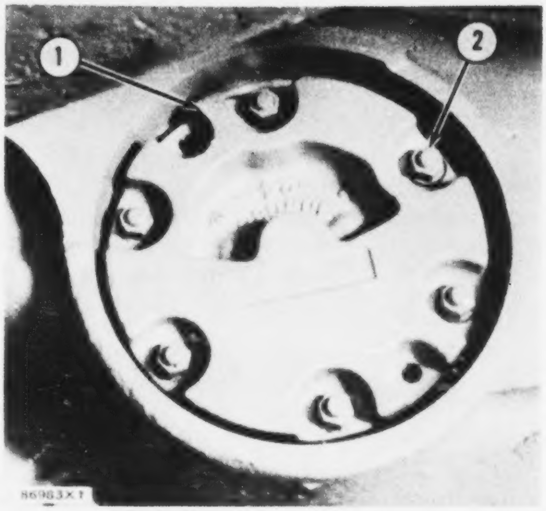
20. Fill the final drive case and steering clutch compartment with oil to the correct levels.

end by:
a) install track roller frames

FINAL DRIVE OIL PUMP

REMOVE FINAL DRIVE OIL PUMP 11–4060

1. Remove the oil from the final drive case.
2. Remove nuts (2).
3. Install two 3/8"–16NC forcing screws in the oil pump. Tighten the forcing screws evenly and make a separation of the oil pump from the bevel gear case.
4. Remove the final drive oil pump (1).

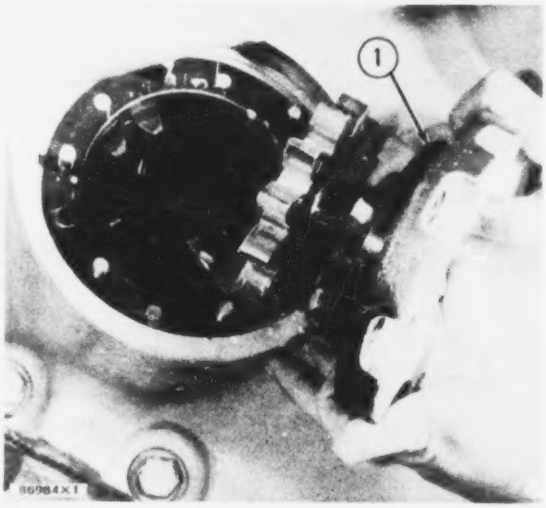


INSTALL FINAL DRIVE OIL PUMP 12–4060

1. Put the final drive oil pump (1) in position over its studs on the bevel gear case.

NOTE: Make sure the teeth of the oil pump gear engage in the teeth of the idler pinion.

2. Install the nuts that hold the oil pump to the bevel gear case.
3. Fill the final drive case with oil to the correct level.



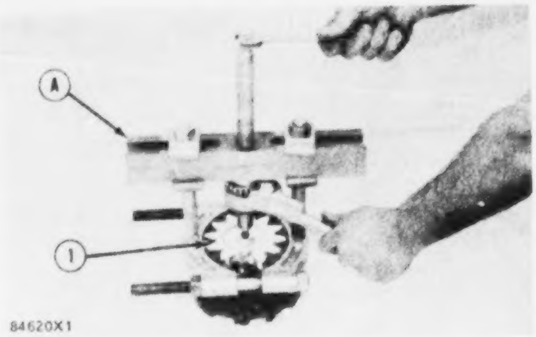
FINAL DRIVE OIL PUMP

DISASSEMBLE FINAL DRIVE OIL PUMP 15–4060

Tools Needed		A	B
8B7551	Bearing Pulling Attachment	1	
8B7548	Puller Assembly	1	
8B7550	Leg	1	
8H684	Ratchet Box Wrench	1	
1P529	Handle		1
1P460	Drive Plate		1
1P456	Drive Plate		1

start by:
a) remove final drive oil pump

1. Remove the nut and lock from gear (1). Install tooling (A) and remove the gear.
2. Remove the key from the gear shaft.
3. Remove bolts (5) and locks (3).
4. Remove cover (7). Remove bearing (6) from the cover with tooling (B).
5. Remove two gears (2) from body (4).
6. Remove the bearing from the body.



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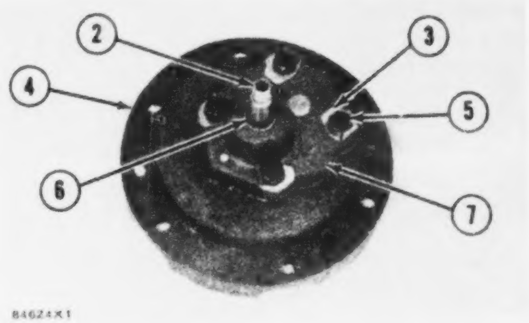

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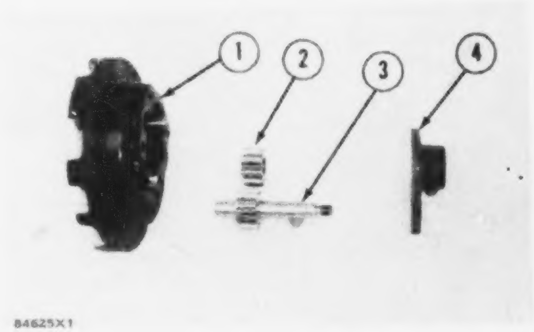
ASSEMBLE FINAL DRIVE OIL PUMP 16–4060

Tools Needed		A
1P529	Handle	1
1P460	Drive Plate	1
1P456	Drive Plate	1

1. Install the bearings in the body and cover with tooling (A).
2. Install gears (2) and (3) into the body (1).
3. Put the cover (4) in position on the body. Install the bolts and locks that hold the body and cover together.
4. Install the key in the shaft for gear (3). Install gear (5) over the key.
5. Install lock (7) and nut (6) that hold the gear on the shaft. Tighten nut (6) to a torque of 25 ± 5 lb.ft. (3.5 ± 0.7 mkg).

end by:
a) install final drive oil pump



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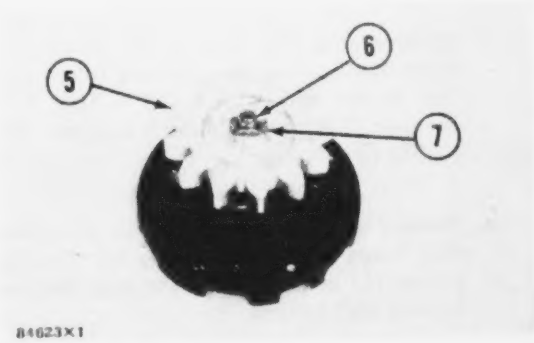

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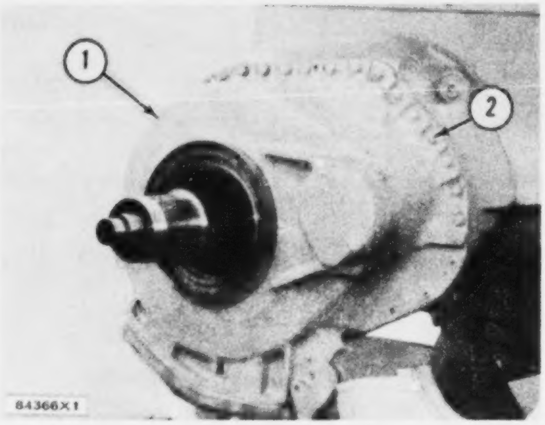
FINAL DRIVE CASES

REMOVE FINAL DRIVE CASES 11–4059

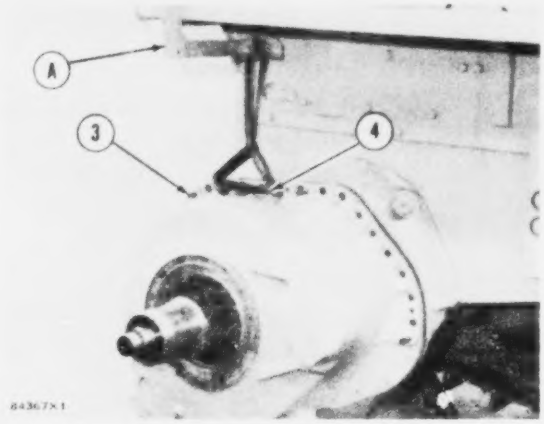
Tools Needed		A	B
FT120	Lifting Bracket	1	
8B7554	Bearing Cup Pulling Attachment		1
8B7548	Puller Assembly		1
8H684	Ratchet Box Wrench		1

start by:
a) remove sprockets
b) remove final drive oil pumps

CAUTION: The oil pump for final drive must be removed before removing the final drive case. The idler pinion can fall on the drive shaft for the oil pump and cause damage to it.

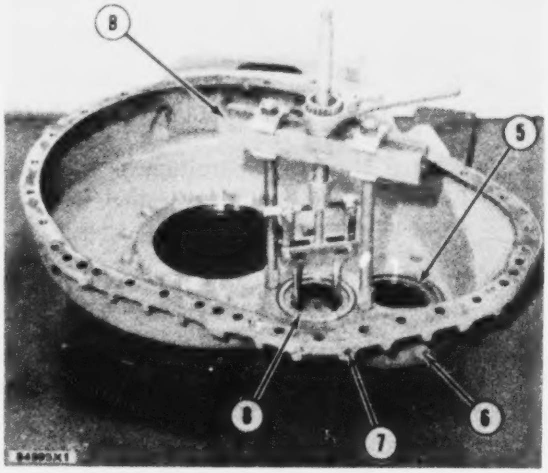


1. Remove bolts (2) that hold final drive case (1) to the bevel gear case.



2. Install four 5/8"–11NC guide bolts, 5 in. (12.7 cm) long, through the case into the bevel gear case. Install three 5/8"–11NC forcing screws (3) into the case. Make a separation of the final drive and bevel gear cases. Install two 5/8"–11NC forged eyebolts (4) in the final drive case. Fasten a hoist and tool (A) to the eyebolts. Remove the final drive case. Weight is 500 lb. (227 kg).

CAUTION: Keep the idler pinion in position in the bevel gear case when making a separation of the final drive and bevel gear cases. Use a wire to keep the idler pinion in position after the final drive case is removed.



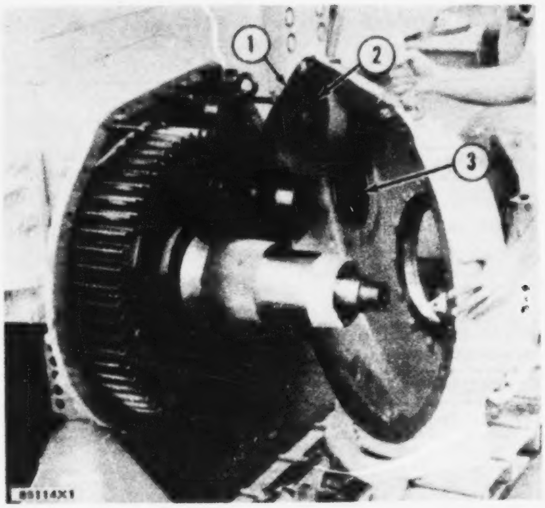
3. Remove plug (7). Remove the dowel that keeps the outer pinion bearing (6) in position in the case with a 1/4"–20NC bolt. Remove the outer pinion bearing with tooling (B).

4. Remove cap plug (8). Remove the dowel that keeps the outer bearing for the idler pinion (5) in position in the case. Remove bearing with tooling (B).

FINAL DRIVE CASES

INSTALL FINAL DRIVE CASES 12–4059

	Tools Needed	A
FT120	Lifting Bracket	1

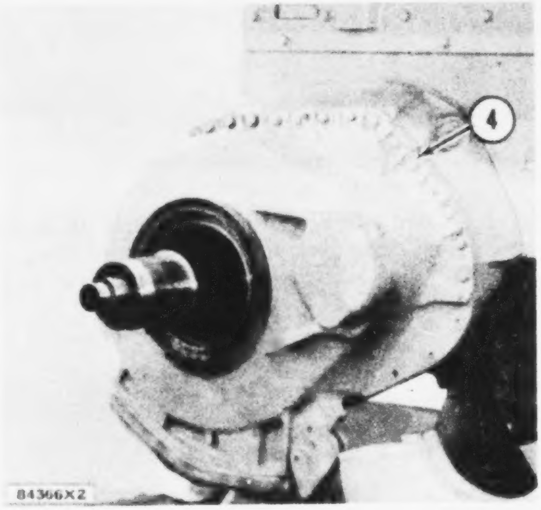


1. Lower the temperature for the outer bearings for the pinion (2) and idler pinion (3). Install the bearings in their bores in the final drive case. Put the holes in the bearings in alignment with the holes in the case. Install the dowels and cap plugs that hold the bearings in position in the case.

2. Remove the old gasket material from the surfaces that seal the cases for the final drive and bevel gear. Put 7M7260 Liquid Gasket Material on the surfaces.

3. Install four 5/8"–11NC guide pins, 5 in. (12.7 cm) long, in the bevel gear case.

4. Fasten a hoist and tool (A) to the final drive case (1) and put it in position on the guide pins. Make sure that the shafts for the pinion and idler pinion engage in their bearings.



5. Install bolts (4) that hold the final drive and bevel gear cases together. Remove the four guide pins and install four bolts. Tighten the bolts to a torque of 200 ± 20 lb.ft. (27.7 ± 2.8 mkg).

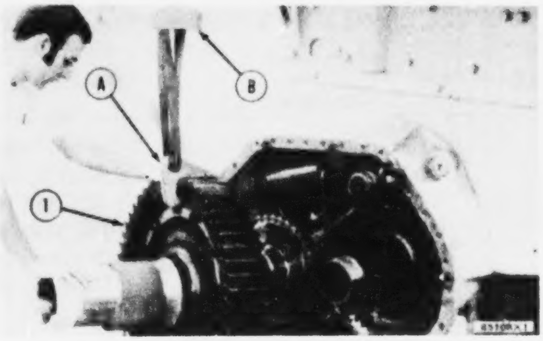
end by:
  a) install final drive oil pumps
  b) install sprockets

FINAL DRIVE GEARS AND IDLER PINION

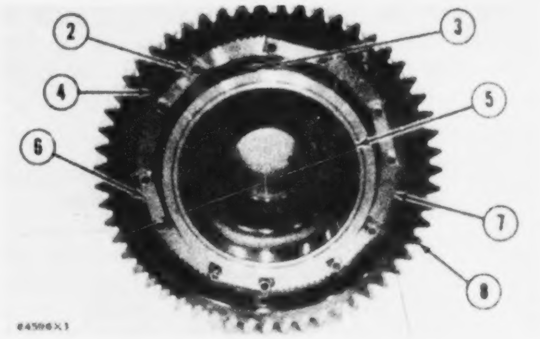
REMOVE FINAL DRIVE GEARS AND IDLER PINION 11–4055 & 11–4091

Tools Needed		A	B	C	D	E
FT791	Lifting Bracket	1				
FT120	Lifting Bracket		1			
5F7343	Bearing Pulling Attachment			1		
1P820	Puller Assembly			1		
5F7342	Adapter			2		
8B7561	Step Plate			1		1
3H465	Plate			4		
1B4207	Nut			2		
9S5800	Hydraulic Pump			1		
8B7554	Bearing Cup Pulling Attachment				1	
8B7548	Puller Assembly				1	1
8H684	Ratchet Box Wrench				1	1
8B7551	Bearing Pulling Attachment					1

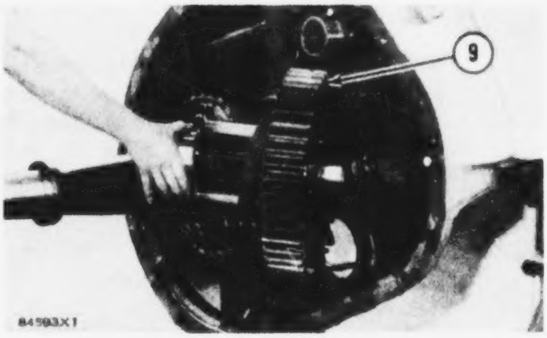
start by:
a) remove final drive cases



1. Put tape on the threads of the sprocket shaft and final drive hub to prevent damage during removal and installation.

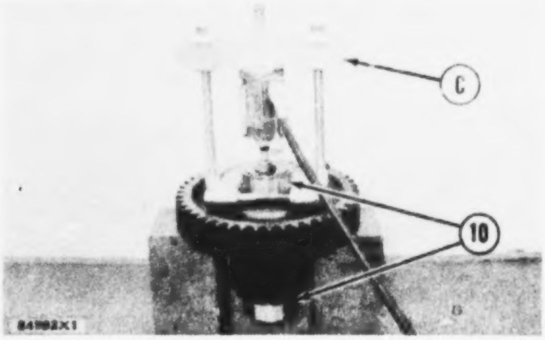


2. Fasten a hoist and tools (A) and (B) to the final drive gear and hub. Remove the gear and hub as a unit (1). Weight is 500 lb. (227 kg).



3. Remove bolt (3) and lock. Remove the bearing race from the hub.

4. Remove nuts (2), locks (6), plates (4), and bolts. Remove hub (7) from gear (8). Weight of hub is 240 lb. (109 kg). Weight of gear is 235 lb. (107 kg).

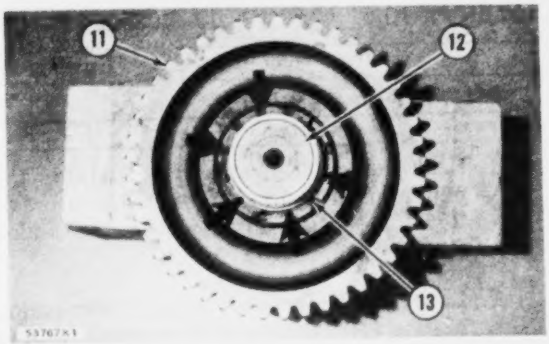


5. Fasten a hoist and tool (B) to idler pinion (9) and remove it from the bevel gear case. Weight is 185 lb. (39 kg).

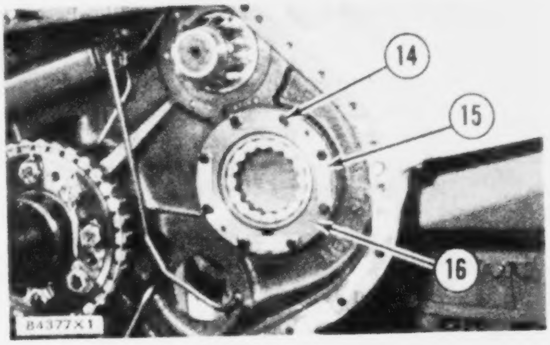
6. Remove bearing races (10) from each end of the idler pinion with tooling (C).

FINAL DRIVE GEARS AND IDLER PINION

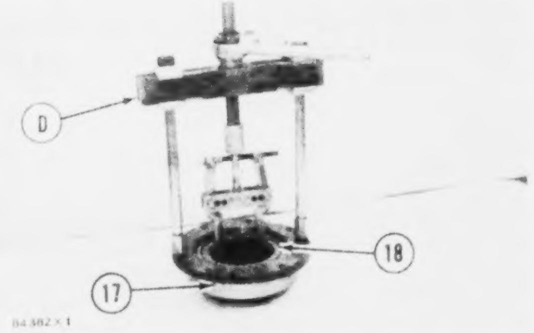
7. Put the idler pinion on blocks so the lower end of the pinion shaft is approximately 3 in. (7.6 cm) off the floor. Cut retainer (13) between every second spline as shown by arrows. Move the pieces of the retainer into the grooves in the idler pinion shaft far enough to clear the splines of the idler gear. Hit the top of the idler shaft with a hammer and remove the gear (11) from the idler pinion (12). Weight of the idler pinion is 95 lb. (43 kg). Weight of the idler pinion gear is 90 lb. (41 kg).



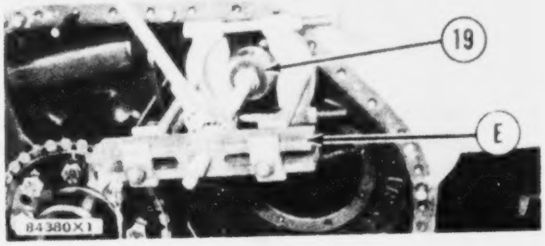
8. Remove the oil from the steering clutch compartment before removing the bearing cage (16) for the idler pinion.



9. Remove bolts (14) and locks (15). Install two 1/2"–13NC forcing screws in the bearing cage. Tighten the forcing screws evenly and remove the bearing cage.



10. Remove dowel (17) from the bearing cage with a 1/4"–20NC bolt. Remove the bearing (18) with tooling (D).



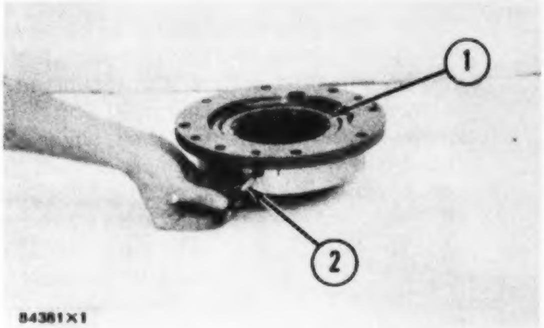
11. Remove the outer race (19) for the pinion with tooling (E).

FINAL DRIVE GEARS AND IDLER PINION

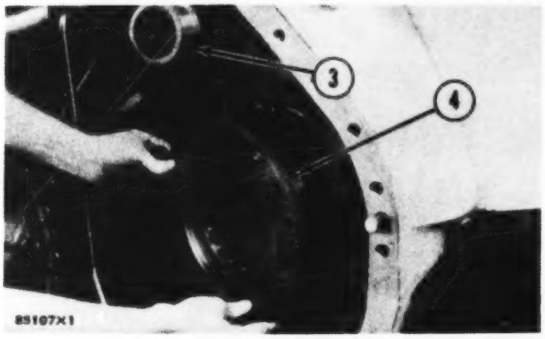
INSTALL FINAL DRIVE GEARS AND IDLER PINION 12–4055 & 12–4091

Tools Needed		A	B
FT120	Lifting Bracket	1	
FT791	Lifting Bracket		1

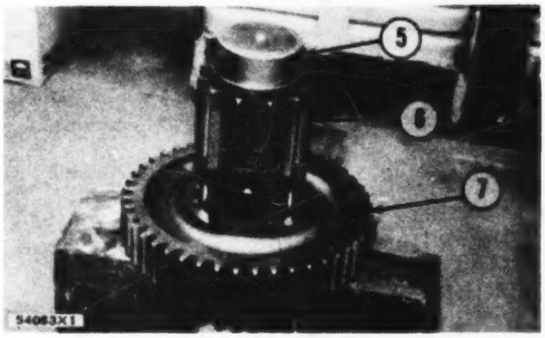
1. Heat the outer bearing race (3) for the pinion in oil to a maximum temperature of 275°F (135°C). Install it on the pinion shaft.
2. Lower the temperature of inner idler pinion bearing (1). Install it in its bearing cage. Put the dowel hole in the bearing in alignment with the hole in the cage. Install dowel (2).



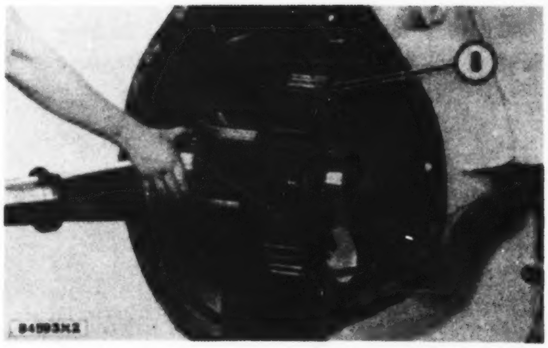
3. Remove old gasket material from the sealing surfaces of the bearing cage for the idler pinion and the bevel gear case. Put 7M7260 Liquid Gasket Material on the surfaces.
4. Put bearing cage (4) for the idler pinion in position of the bevel gear case. Install the bolts that hold it.



5. Heat the bearing races (5) for the idler pinion in oil to a maximum temperature of 275°F (135°C). Install the races on the idler pinion.
6. Put the idler pinion gear (7) on blocks with the 45° bevels at the top. Install a new retainer in the grooves of the idler pinion. Put the idler pinion (6) on the idler gear with the retainer toward the 45° bevels. Make sure that the splines in the gear and pinion are in alignment. Put a force down on the idler pinion until it engages in the idler gear. Make sure that the retainer engages in the grooves of the idler gear.



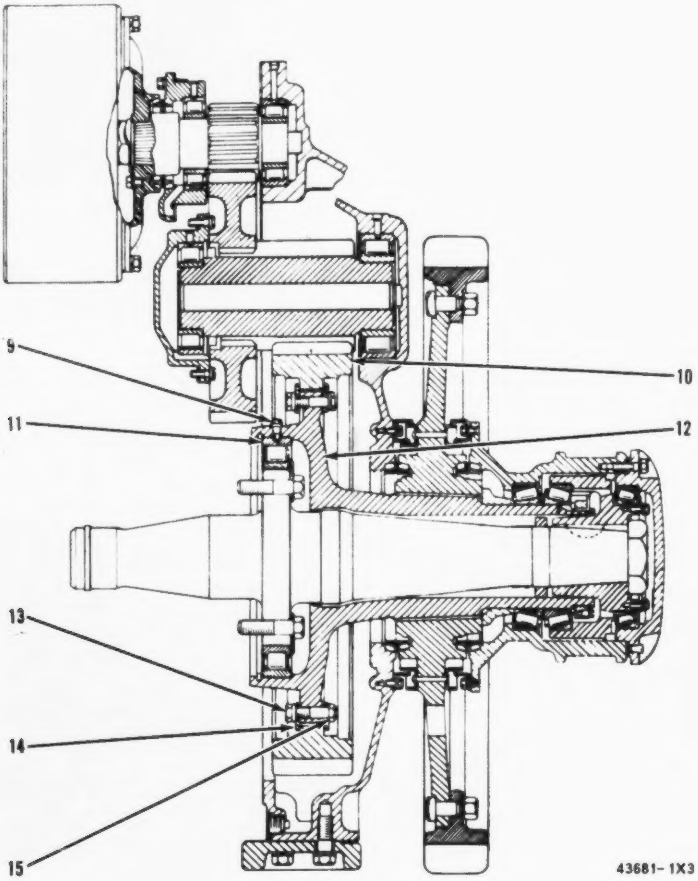
7. Fasten a hoist and tool (A) to the idler pinion (8). Install it in its bearing in the bevel gear case. Keep the idler pinion in position with a wire.



FINAL DRIVE GEARS AND IDLER PINION

8. Lower the temperature of bearing race (11). Install it in the final drive hub (12). Put the holes in the race and hub in alignment. Install bolt (9) and lock that hold it.
9. Put the teeth of the hub in alignment with the teeth of the final drive gear (10). Install bolts (13), plates (14), locks, and nuts (15).
10. Fasten a hoist and tools (A) and (B) to the gear and hub as a unit. Install the unit over the sprocket shaft and bearing. Make sure the teeth of the final drive gear engage in the teeth of the idler pinion.
11. Fill the steering clutch compartment with oil to its correct level.

end by:
  a) install final drive cases



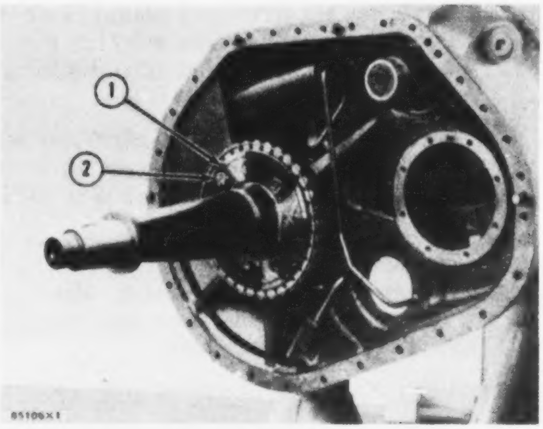
SPROCKET SHAFTS

REMOVE SPROCKET SHAFTS 11–4058

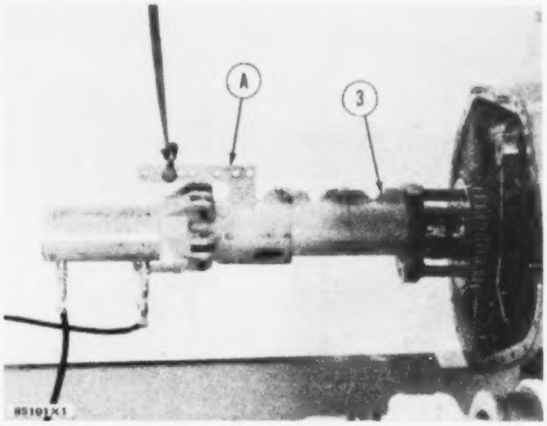
Tools Needed		A	B
7M9774	Coupling	1	
7M9773	Adapter	1	
7M9772	Pin	1	
9S8901	Cylinder Group	1	
9S5433	Adapter	3	
5H6197	Pin	3	
8S6377	Lock	3	
9S5431	Sleeve Assembly	1	
5P2677	Leg	8	
5P2679	Plate	1	
FT120	Lifting Bracket		1

start by:

a) remove final drive gears and idler pinion

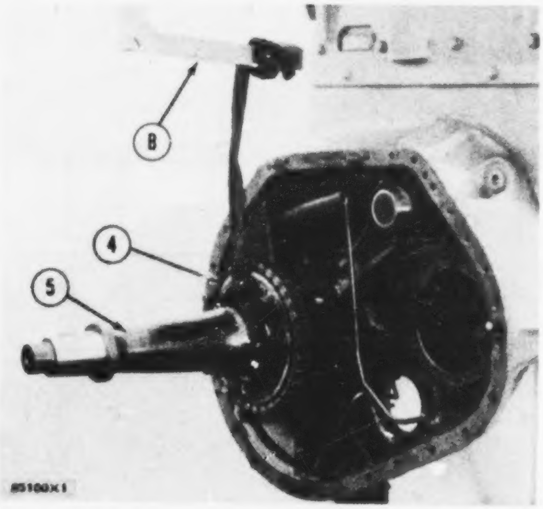


1. Remove bolts (2) and retainers (1).



2. Install tooling (A) on the sprocket shaft. Make sure that the distance from the front face of the nuts on the stud assembles to the bevel gear case is the same on all the stud assemblies.

3. Put enough force on the shaft to move it from the bevel gear case. Another adapter (3) must be added to completely loosen the sprocket shaft.



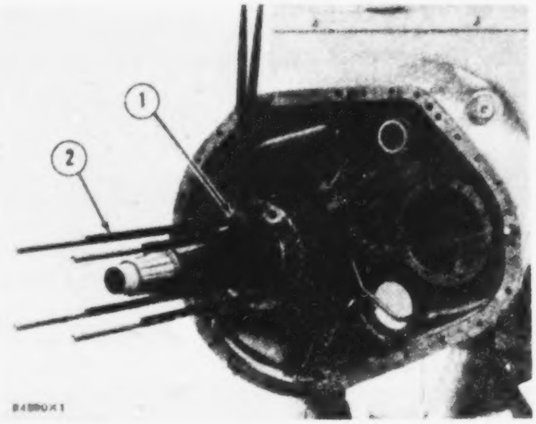
4. Remove all of tooling (A) except the stud assemblies. Fasten a hoist and tool (B) to the sprocket shaft. Remove the stud assemblies. Remove the sprocket shaft (5).

5. Remove bearing (4) from the shaft with a hammer and punch.

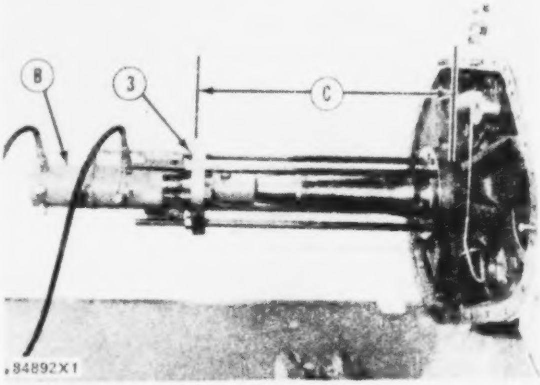
SPROCKET SHAFTS

INSTALL SPROCKET SHAFTS 12–4058

Tools Needed		A	B
FT120	Lifting Bracket	1	
5P2678	Stud		4
5P2680	Plate		1
2J3505	Nut		4
5F9881	Bolt		2
7M9772	Pin		1
7M9773	Adapter		1
7M9774	Coupling		1
9S8900	Cylinder Group		1



1. Fasten a hoist and tool (A) to the sprocket shaft (1) and put it in position in the bevel gear case. Make sure the groove for the key in the shaft is at the top. Install studs (2) from tooling (B) to keep the shaft in position.



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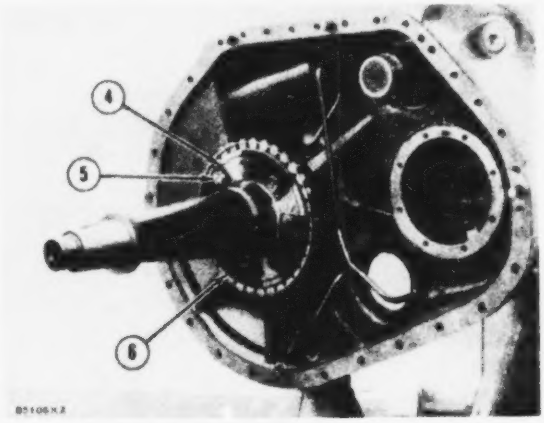
2. Install tooling (B) on the shaft.

3. Put a small amount of force on the shaft to put tooling (B) in alignment with the shaft. Make an adjustment to nuts (3) so the distance (C) is the same on all the studs.

4. Put force on the sprocket shaft until its flange is against the bevel gear case.

5. Remove tooling (B).



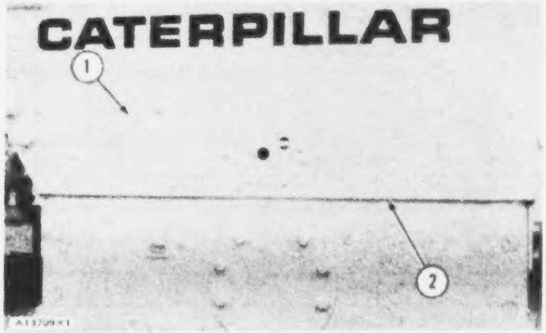
6. Heat bearing (6) in oil to a maximum temperature of 275°F (135°C). Install the bearing on the sprocket shaft. Make sure the bearing is even with the bevel gear case.

7. Install retainers (4) and bolts (5). Tighten the bolts by hand to a torque of 550 ± 50 lb.ft. (76.1 ± 6.9 mkg).

end by:
  a) install final drive gears and idler pinion

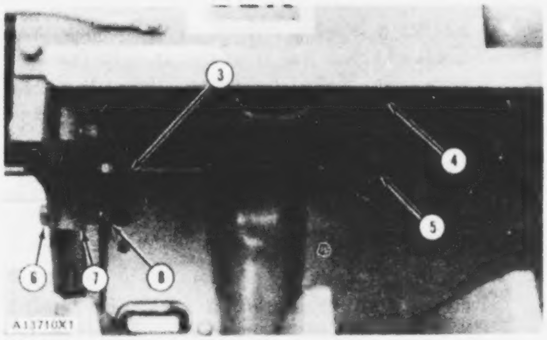
FUEL TANK

REMOVE FUEL TANK 11–1273



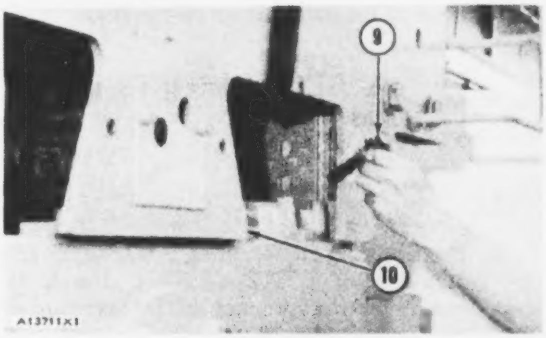
1. Remove covers (1) and (2) from the support.

2. Remove two bolts (3) and (5) from both sides of the machine.

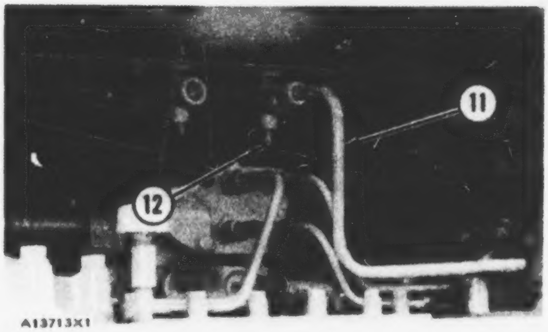


3. Remove nuts (8), bolts (6), and shims (7) from both sides of the machine. Put identification on the shims to prevent mixing at assembly.

4. Remove three bolts (4) from both sides of the machine.



5. Fasten a hoist to the support. Remove two bolts (9) that hold the support to the bevel gear case. Remove support (10). Weight of the support is 700 lb. (317.5 kg).

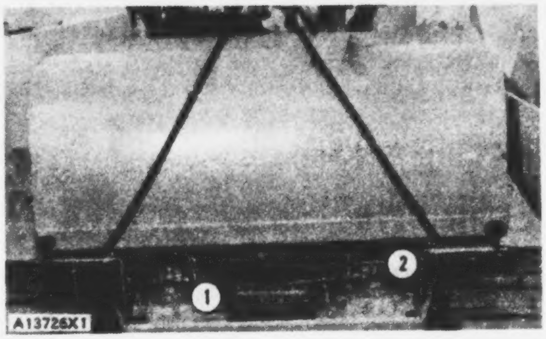


6. Close valve (12) on the bottom of the fuel tank. Disconnect fuel line (11) from the valve.

7. Fasten a hoist to the fuel tank. Remove the fuel tank. Weight of the fuel tank is 400 lb. (181.4 kg).

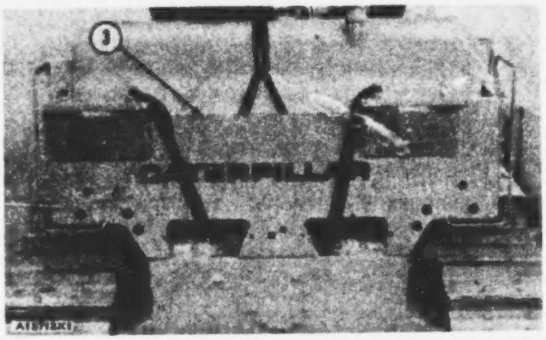
FUEL TANK

INSTALL FUEL TANK 12–1273



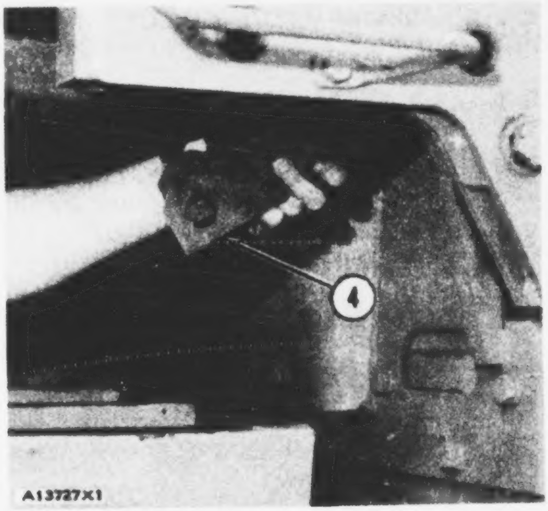
1. Fasten a hoist to the fuel tank. Put the tank in position on the fenders of the machine. Install the four bolts that hold the fuel tank (1) in position.

2. Connect fuel line (2) to the valve on the bottom of the fuel tank. Turn the valve in the "ON" position.



3. Fasten a hoist to the support. Put support (3) in position behind the fuel tank.

4. Install the two bolts that hold the support to the bevel gear case.



5. Put shims (4) between the support and the fenders. Install the bolts and nuts that hold the support to the fenders.

NOTE: Make sure the shims are in the correct position behind the support.

6. Install the three bolts that hold the support to the front part of the fender.

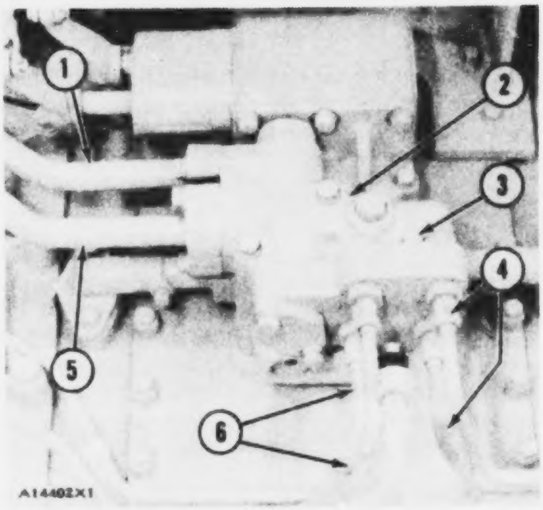
7. Install the two covers over the openings in the rear of the support.

BRAKE HYDRAULIC MECHANISM AND STEERING CLUTCH HYDRAULIC CONTROL RELIEF VALVE (DIRECT DRIVE)

REMOVE BRAKE HYDRAULIC MECHANISM AND STEERING CLUTCH HYDRAULIC CONTROL RELIEF VALVE (DIRECT DRIVE) 11–5069

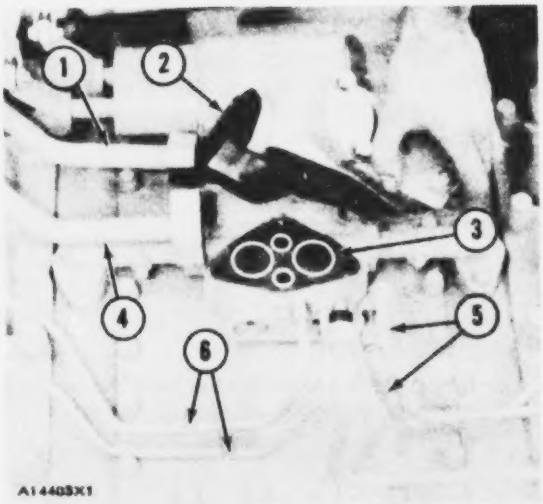
NOTE: The fuel tank is removed for better illustration of the brake hydraulic mechanism and steering clutch hydraulic control relief valve.

1. Disconnect oil lines (1) and (5) from the relief valve.
2. Disconnect two lines (6) and two lines (4) from the relief valve.
3. Remove bolts (3) and washers that hold the relief valve in position. Remove the relief valve (2).
4. Remove the seals from the steering clutch hydraulic control valve. If the seals have damage, use new parts for replacement.



INSTALL BRAKE HYDRAULIC MECHANISM AND STEERING CLUTCH HYDRAULIC CONTROL RELIEF VALVE (DIRECT DRIVE) 12–5069

1. Install new seals (3) in the steering clutch hydraulic control valve.
2. Put relief valve (2) in position on the steering clutch hydraulic control valve. Install the bolts and washers that hold it.
3. Connect oil lines (1) and (4) to the relief valve.
4. Connect two lines (6) and two lines (5) to the relief valve.



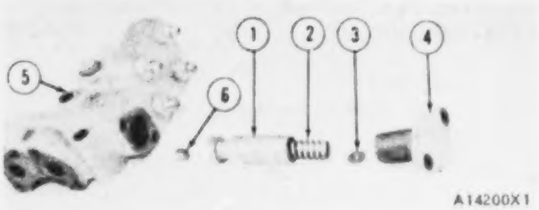
BRAKE HYDRAULIC MECHANISM AND STEERING CLUTCH HYDRAULIC CONTROL RELIEF VALVE (DIRECT DRIVE)

DISASSEMBLE BRAKE HYDRAULIC MECHANISM AND STEERING CLUTCH HYDRAULIC CONTROL RELIEF VALVE (DIRECT DRIVE) 15–5069

start by:

a) remove brake hydraulic mechanism and steering clutch hydraulic control relief valve

WARNING: Cover (4) is under spring tension. Hold the cover in position when the bolts that hold it to housing (5) are removed.



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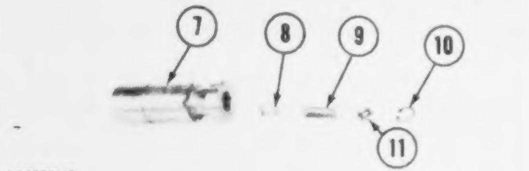

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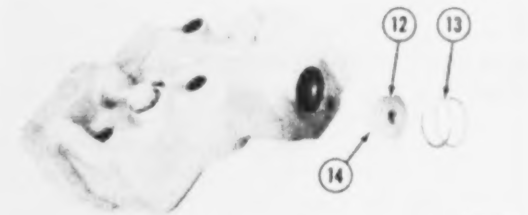
1. Remove two bolts and washers that hold cover (4) in position. Remove the cover.
2. Remove spacers (3), spring (2) and valve assembly (1) from the housing (5).
3. Remove slug (6) from the valve assembly.
4. Remove ring (10), retainer (11), spring (9) and plunger (8) from valve spool (7).
5. Remove ring (13) and plug (12) from the housing. Remove seal (14) from the plug. If the seal has damage, use new parts for replacement.



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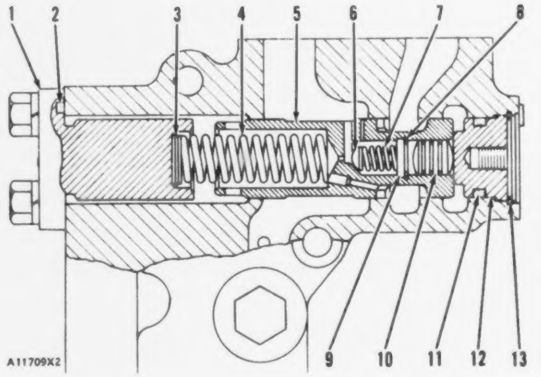
ASSEMBLE BRAKE HYDRAULIC MECHANISM AND STEERING CLUTCH HYDRAULIC CONTROL RELIEF VALVE (DIRECT DRIVE) 16–5069

1. Make sure all of the parts of the brake hydraulic mechanism relief valve are clean and free of dirt and foreign material. Put clean SAE 30 oil on all of the parts.
2. Install plunger (6) in valve spool (5). Install spring (7), retainer (9), ring (8) and slug (10) in the valve spool.
3. Install a new seal (11) on plug (12). Install the plug in the housing. Install ring (13).
4. Put the valve assembly in the housing. Install spring (4).
5. Install spacers (3) in cover (1). Install seal (2) in cover (1). Install the cover in the housing. Install the bolts and washers that hold it.

end by:

a) install brake hydraulic mechanism and steering clutch hydraulic control relief valve



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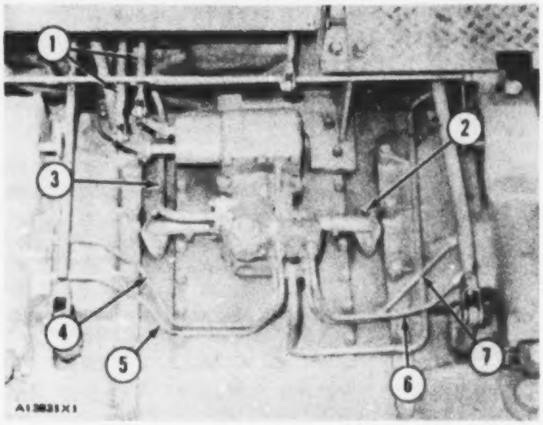
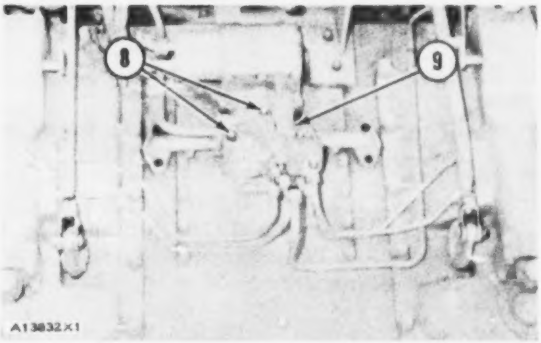
STEERING CLUTCH HYDRAULIC CONTROL VALVE

REMOVE STEERING CLUTCH HYDRAULIC CONTROL VALVE 11–4102

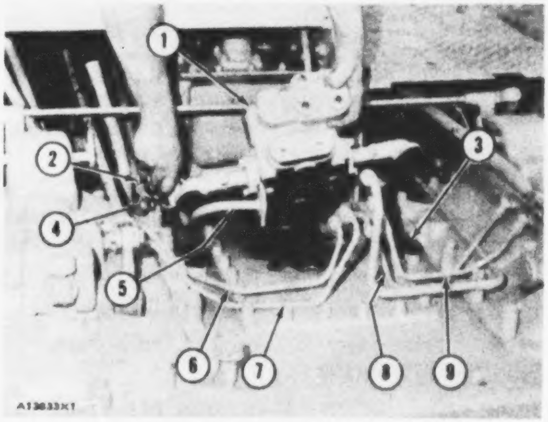
start by:
a) remove fuel tank



1. Disconnect two rods (1) from the levers of the steering clutch hydraulic control valve.
2. Disconnect oil line (3).
3. Disconnect four lines (4), (5), (6) and (7) from the brake hydraulic mechanism housing.
4. Remove four bolts (2) that hold the flange to the bevel gear case.
5. Remove four bolts (8). Remove steering clutch hydraulic control valve (9).
6. Check the seals in the bevel gear case and the steering clutch hydraulic control valve. If the seals have damage, use new parts for replacement.



INSTALL STEERING CLUTCH HYDRAULIC CONTROL VALVE 12–4102



1. Install new seals (3) in the bevel gear case and the steering clutch hydraulic control valve. Put clean SAE 30 oil on the seals.
2. Put the steering clutch hydraulic control valve (1) in position on the bevel gear case.
3. Install the four bolts that hold it.
4. Install the four bolts that hold the flange to the bevel gear case.
5. Connect four lines (6), (7), (8) and (9) to the brake hydraulic mechanism housing.
6. Connect oil line (5) to the steering clutch hydraulic control valve.
7. Connect two rods (2) and (4) to the levers.

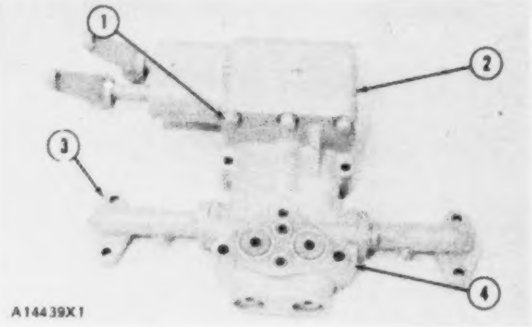
end by:
a) install fuel tank

STEERING CLUTCH HYDRAULIC CONTROL VALVE

DISASSEMBLE STEERING CLUTCH HYDRAULIC CONTROL VALVE 15–4102

start by:
- a) remove steering clutch hydraulic control valve
- b) remove brake hydraulic mechanism and steering clutch hydraulic control relief valve (direct drive)

1. Remove five bolts (1). Remove housing (4) from housing (2). Remove bolts that hold two flanges (3) to housing (4). Remove flanges (3).



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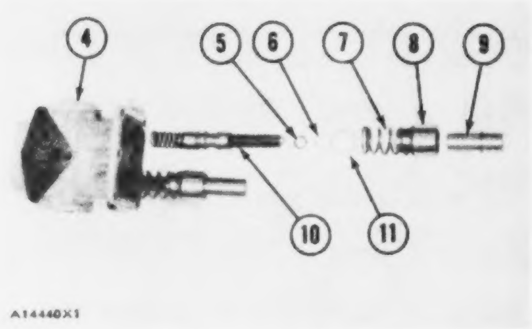
2. Remove two valve assemblies (10) from housing (4).



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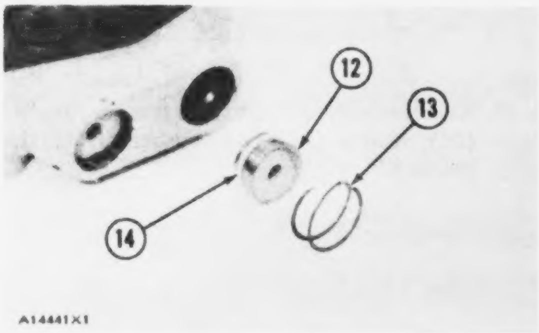
3. Remove plunger (9), bushings (8), spring (7), washer (11), retainer (6) and washer (5) from the valve. Disassemble the other valve the same way.



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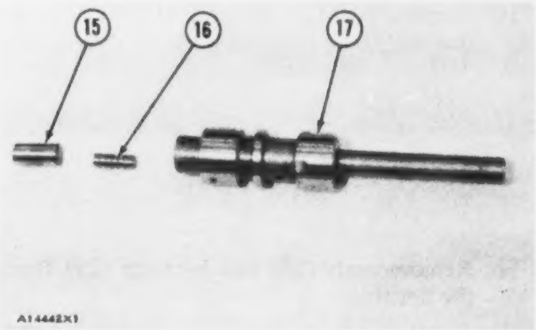
4. Remove ring (13) and plug (12) from housing (4). Remove seal (14) from the plug. Remove the other plug from the housing.

5. Remove slug (15) and piston (16) from valve spool (17).



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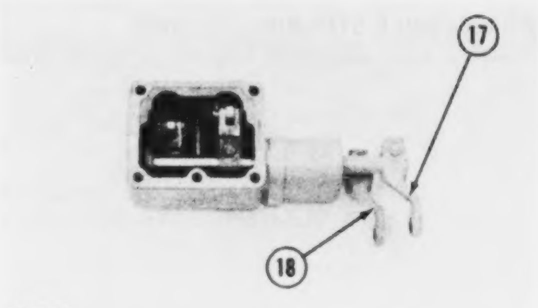
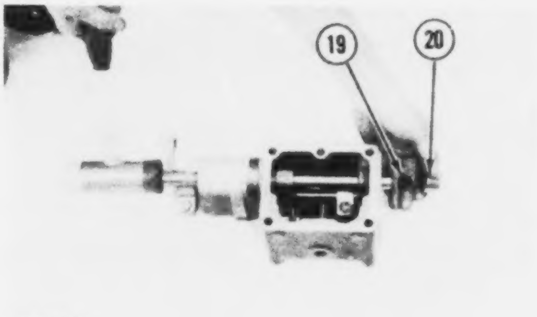
STEERING CLUTCH HYDRAULIC CONTROL VALVE

6. Remove levers (17) and (18) from the shafts. Remove the keys from the shafts.



85889X2

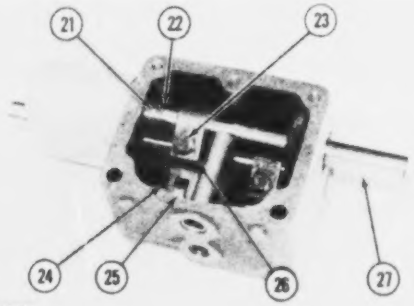
7. Hit the ends of the shafts with a soft faced hammer. Remove spacers (19) and bearings (20).



85887X2

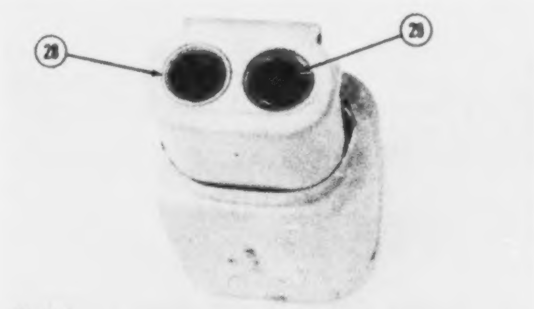
8. Remove snap ring (22) and washer (21) from the shaft.

9. Remove bolts (23). Remove lever assemblies (26), shafts (27) and washers from the housing.



A14443X1

10. Remove pins (24) and rollers (25) from the levers.



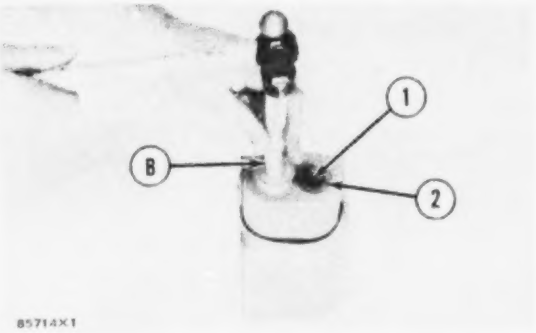
A14444X1

11. Remove seals (28) and bearings (29) from the housing.

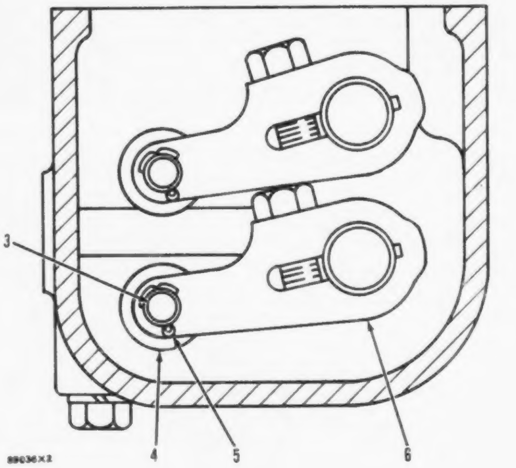
STEERING CLUTCH HYDRAULIC CONTROL VALVE

ASSEMBLE STEERING CLUTCH HYDRAULIC CONTROL VALVE 16–4102

Tools Needed		A	B
1P529	Handle	1	1
1P462	Drive Plate	1	
1P459	Drive Plate	1	1
1P471	Drive Plate		1

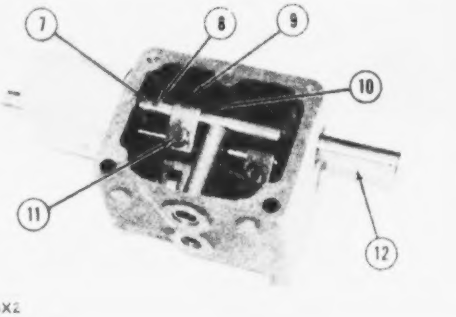


1. Install bearings (1) in the shaft housing with tooling (A). Make sure the bearings are even with the seal bores.



2. Install seals (2) in the shaft housing with tooling (B).

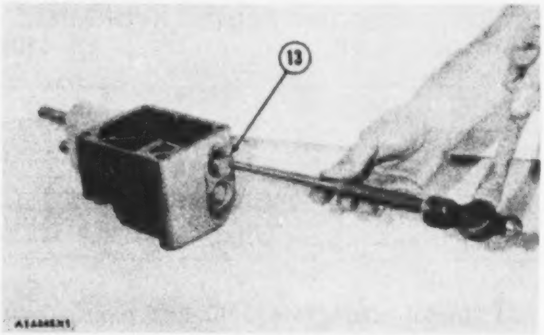
3. Put rollers (4) in position on levers (6). Install pins (3) and cotter pins (5).



4. Slide shaft (12) into position through the bearing end of the housing. Install lever (9), washer (7) and snap ring (8) on shaft (12). Make sure the grooves in the levers are engaged with the keys (10) in the shafts. Tighten bolts (11).

BRAKE HYDRAULIC CONTROLS & ACTUATING MECHANISMS

5. Install bearings and spacers (13) over the ends of the shafts.



6. Put new seals on plugs (19). Install plugs (19) and snap rings (20) in the valve spool housing.

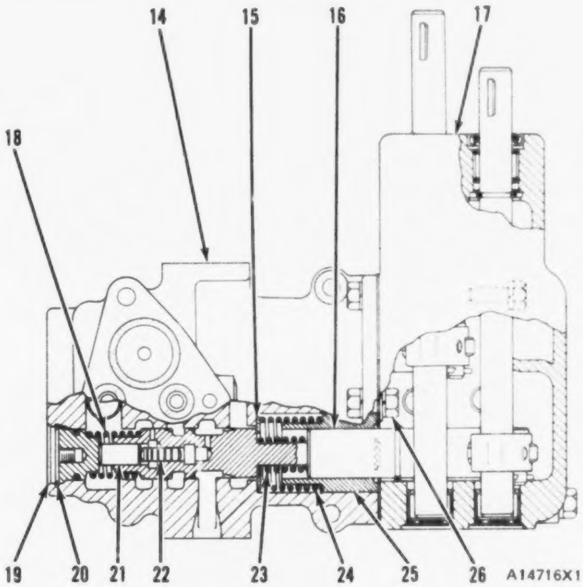
7. Install slugs (22) and pistons (21) in the valve spool. Put springs (18) and (23) into position on the valve spool. Install the valve spool assembly in the housing.

8. Install spacers (15), spring (24), bushing (25) and plunger (16) in the housing. Tighten bolts (26).

9. Put shaft housing (17) in position on valve spool housing (14). Install the bolts that hold the housings together.

end by:

a) install steering clutch hydraulic control valve
b) install brake hydraulic mechanism and steering clutch hydraulic control relief valve (direct drive)

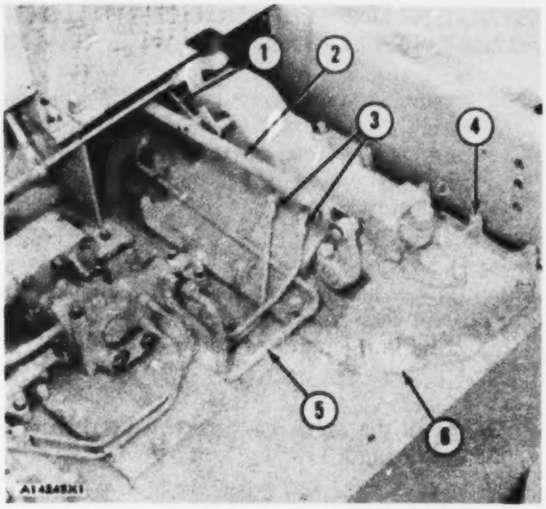


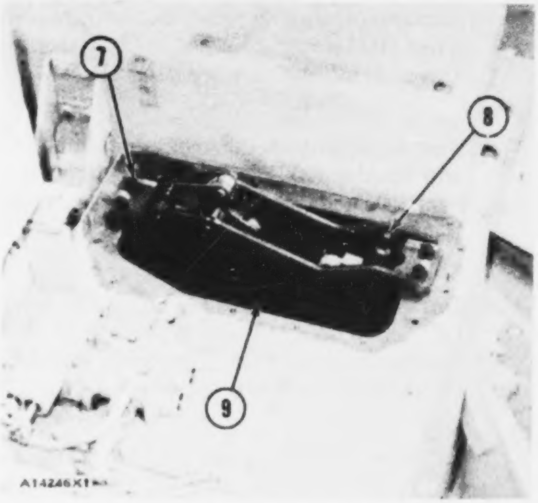
BRAKE HYDRAULIC CONTROLS & ACTUATING MECHANISMS

REMOVE BRAKE HYDRAULIC CONTROLS & ACTUATING MECHANISMS 11–4115

start by:
a) remove fuel tank

1. Remove parking brake linkage (1) from both brake hydraulic controls.
2. Remove brake control rod (2).
3. Remove two oil lines (3).
4. Remove fuel line (5).
5. Remove bolts (4) and spacers that hold the housing to the bevel gear case.
6. Install two 1/2"–13 NC forcing screws in the housing. Tighten the forcing screws evenly until the housing is free of the studs.
7. Fasten a hoist to the housing. Remove housing (6). Weight of the housing is 90 lb. (41 kg).
8. Loosen socket assembly (8) to remove the tension from the brake bands.
9. Remove bolts (7) that hold the brake actuating mechanism to the bevel gear case.
10. Fasten a hoist to the brake actuating mechanism (9) and remove it. Weight of the brake actuating mechanism is 100 lb. (45 kg).

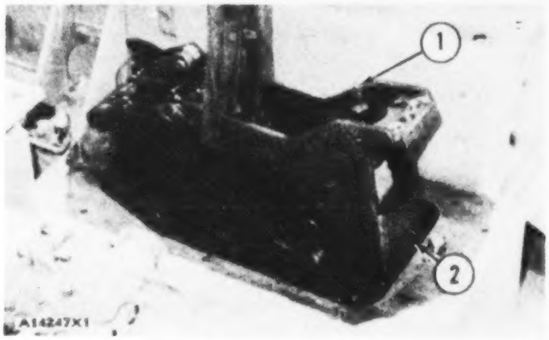




BRAKE HYDRAULIC CONTROLS & ACTUATING MECHANISMS

INSTALL BRAKE HYDRAULIC CONTROLS & ACTUATING MECHANISMS 12–4115

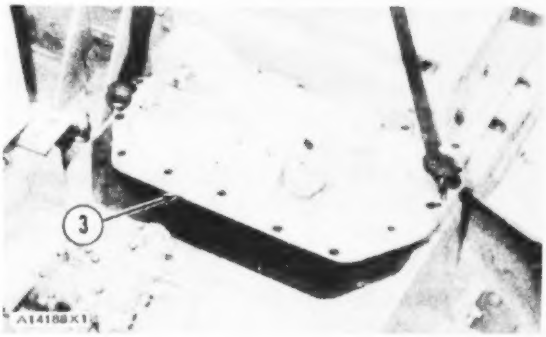
1. Fasten a hoist to brake actuating mechanism (2). Put the machanism in position over the steering clutch. Make sure socket assembly (1) is turned counterclockwise as far as it will go.



2. Lower the mechanism over the studs on the bevel gear case. Make sure struts (7) are engaged in their grooves in brake bands (6).

3. Install the bolts that hold the mechanism in position.

4. Turn socket assembly (1) clockwise until the brake band is tight against the drum. Turn the socket assembly counterclockwise one and one half turns or (nine clicks).



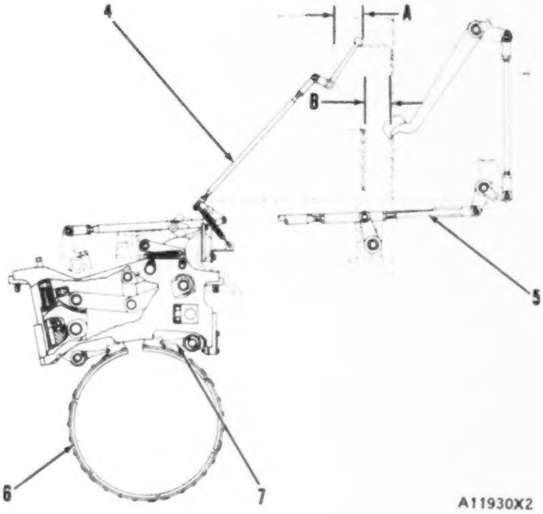
5. Fasten a hoist to the brake hydraulic control housing (3). Put the housing in position over the studs on the bevel gear case. Install the bolts and spacers that hold it.

6. Install rod (5). Turn rod (5) until dimension (B) is 18.66 ± .12 in. (474.0 ± 3.0 mm). Make sure that both of the brake pedals are in alignment with one another.

7. Install rod (4). Turn rod (4) until dimension (A) is 3.50 ± .06 in. (88.9 ± 1.5 mm)

8. Install the fuel line.

9. Install the two oil lines.

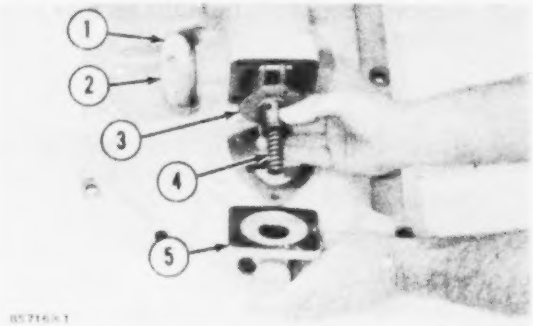


end by:
   a) install fuel tank

BRAKE HYDRAULIC CONTROLS & ACTUATING MECHANISMS

DISASSEMBLE BRAKE HYDRAULIC CONTROLS & ACTUATING MECHANISMS 15–4115

Tools Needed		A	B	C	D
1P529	Handle	1	1	1	1
1P473	Drive Plate	1			
1P459	Drive Plate	1			
1P470	Drive Plate		1		
1P467	Drive Plate		1	1	
1P463	Drive Plate			1	
1P468	Drive Plate				1
1P465	Drive Plate				1

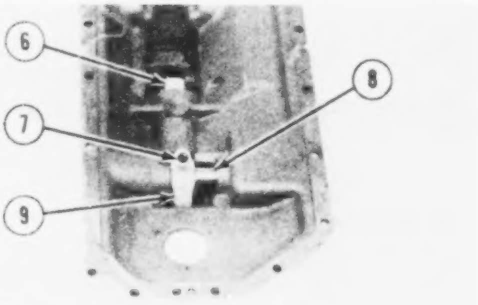


85716X1

start by:
  a) remove brake hydraulic controls and actuating mechanisms

1. Remove the access cover for the brake adjustment screw.

⚠ WARNING: The access cover is under spring pressure. Hold the cover when the bolts that hold it are removed.



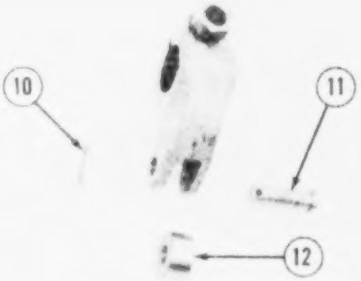
85721X1

2. Pull back on the brake control lever to remove tension from the stop and cover. Remove the bolts and cover (5). Remove spring (4) and stop (3).

3. Loosen bolt (1) and remove lever (2).

4. Loosen nut (7) and pull shaft (8) out of the housing until the key is clear of lever (9). Remove the key, shaft and lever.

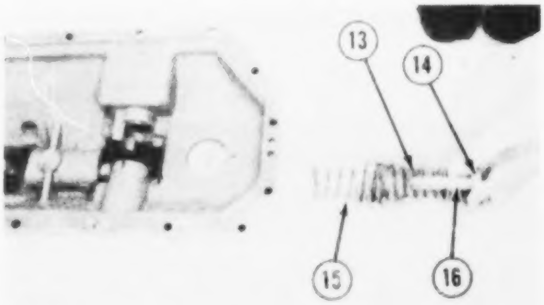
5. Remove piston (6).



85722X1

6. Remove cotter pin (10), pin (11) and roller (12) from lever (9).

7. Remove retainer (14), plunger (16), inner spring (13) and outer spring (15). Remove the ring, valve, spring and plunger from the sleeve.



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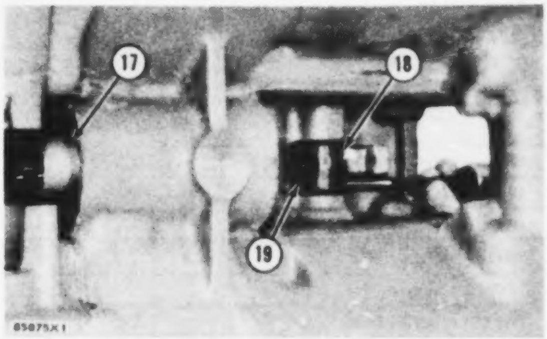
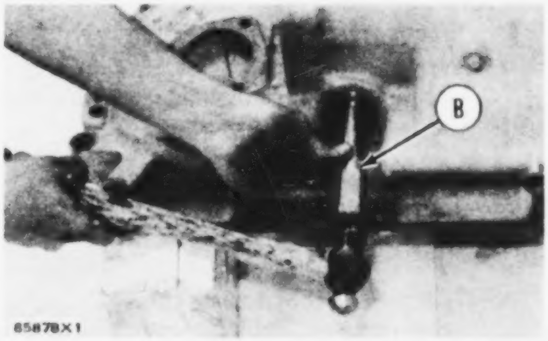
BRAKE HYDRAULIC CONTROLS & ACTUATING MECHANISMS

8. Remove sleeve (17) from the housing with tooling (A).

9. Remove the pin (19) from the parking brake lever and shaft with a hammer and punch. Remove lever (18) and shaft.



10. Remove the cap plug from the brake shaft bore. Remove the bearings and seal for the brake shaft with tooling (B).



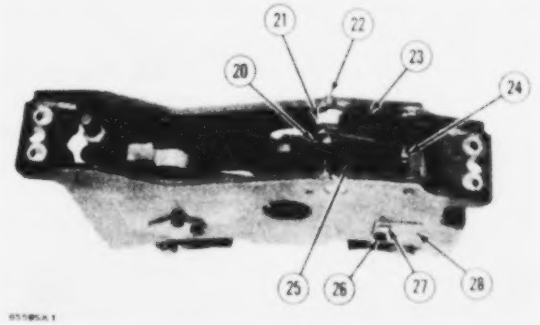
11. Remove the seal for the parking brake shaft.

12. Remove two springs (25).

13. Remove cotter pin (20), pin (22), and roller (21).

14. Remove pin, links (23), and pin (24).

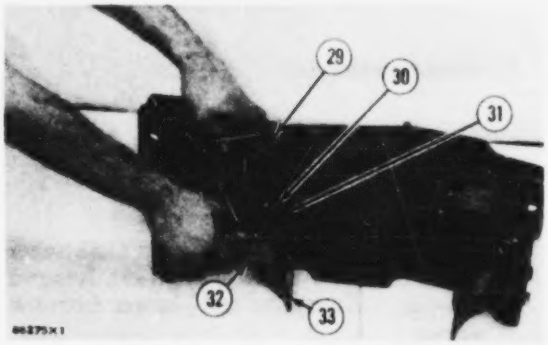
15. Remove bolts (26), lock (27), and brake lever shaft (28).



16. Remove the bolts, lock, and shaft (29). Remove lever (32).

17. Remove cotter pin, washer (31), and pin (30). Remove lever (32) from strut (33).

18. Remove the large bearing from lever (32) with tooling (8). Remove the small bearing from the lever with tooling (C).

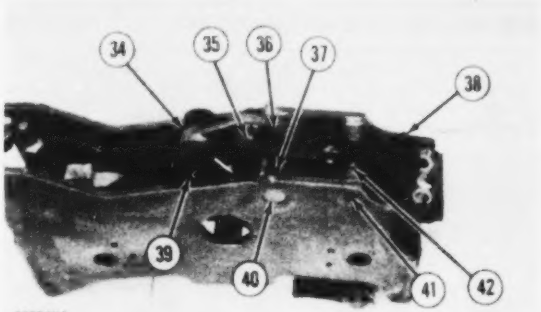


BRAKE HYDRAULIC CONTROLS & ACTUATING MECHANISMS

19. Remove cotter pin and pin (35) from bellcrank (36). Remove pin (37), shaft (40), and the bellcrank. Remove the bearing from the bellcrank with tooling (B).

20. Remove pin (42). Remove shaft (41) and ratchet (38).

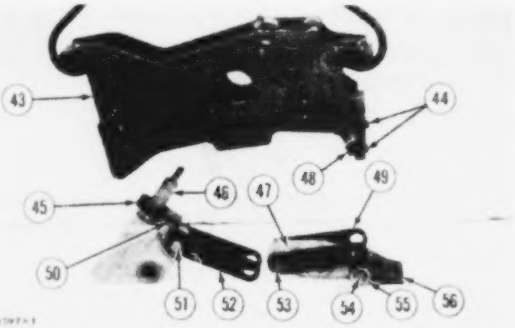
21. Remove snap ring, pin (39), and brake link (34).



22. Fasten a hoist to support (43) and remove it. Weight is 75 lb. (34 kg).

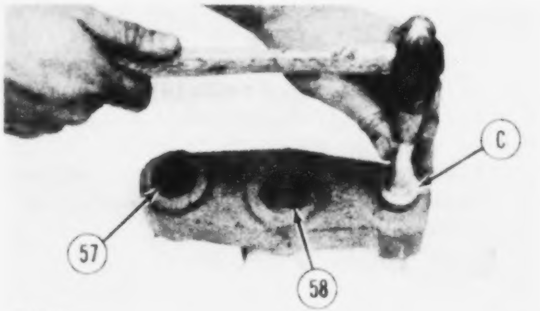
23. Remove two bolts (44) and a lock. Remove shims and plate (48).

24. Remove the snap ring, pin (53), and brake toggle links (49). Remove cotter pin, washer (55), and pin (54). Remove lever (47) from strut (56).



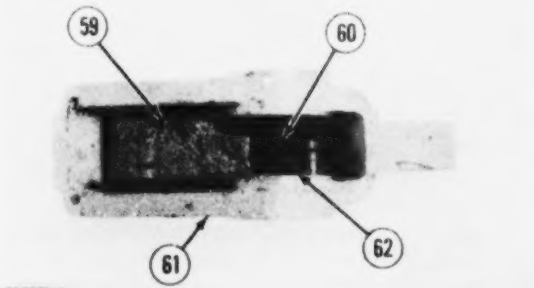
25. Remove cotter pin (51), and brake toggle links (52). Remove bolts (50), spring (45), and socket assembly (46).

26. Remove the small bearing from lever (47) with tooling (C). Remove bearing (58) with tooling (B). Remove bearing (57) with tooling (D).



27. Remove bolt (60), spring (62), and support (59) from lever (61). Remove the adjustment screw.

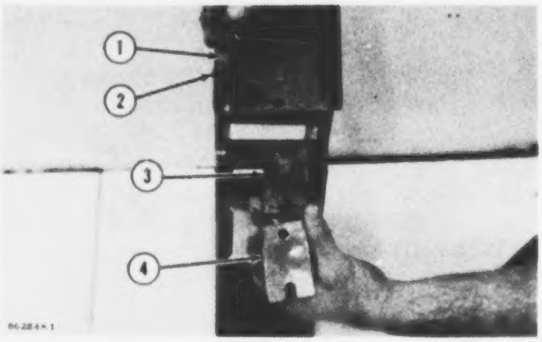
28. Remove the large bearing from lever (62) with tooling (B). Remove the small bearing with tooling (C).



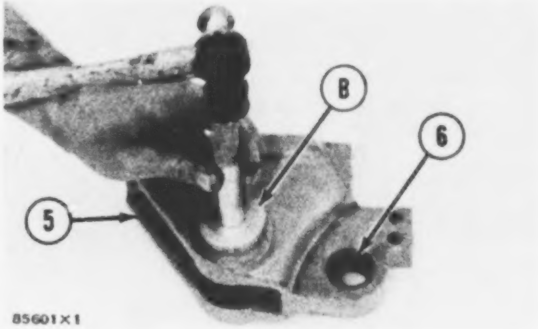
BRAKE HYDRAULIC CONTROLS & ACTUATING MECHANISMS

ASSEMBLE BRAKE HYDRAULIC CONTROLS AND ACTUATING MECHANISMS 16–4115

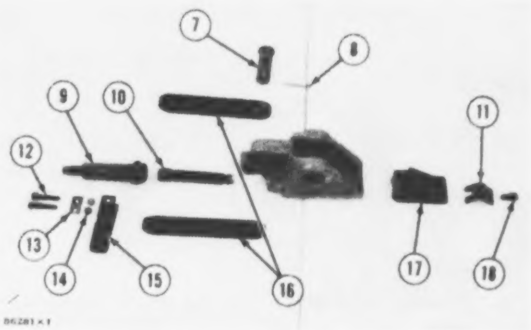
Tools Needed		A	B	C	D	E	F
1P529	Handle	1	1	1	1	1	1
1P478	Drive Plate	1	1				
1P465	Drive Plate	1					
1P467	Drive Plate		1	1		1	
1P470	Drive Plate			1	1		
1P458	Drive Plate				1		
1P485	Drive Plate					1	
1P473	Drive Plate						1
1P459	Drive Plate						1



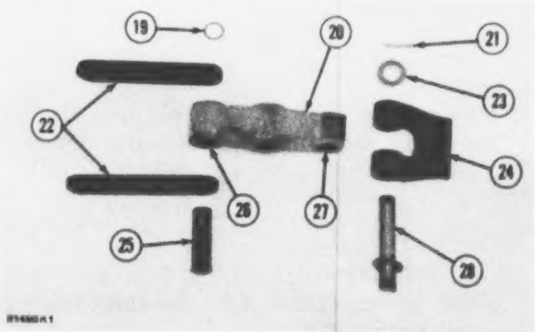
1. Install shims (4), plate (3), bolts (2), and locks (1) on support.



2. Install bearing (6) in lever (5) with tooling (A). Install the large bearing in the lever with tooling (B).



3. Install screw (10) in lever (5). Put socket assembly (9) over screw. Put spring (15) over socket assembly and install the bolts (12), locks (13), and nuts (14) that hold it. Put spring (11) and support (17) in position on the lever and install bolt (18). Put the holes in brake toggle links (16) and the lever in alignment and install pin (7) in the holes. Install cotter pin (8) in the pin.



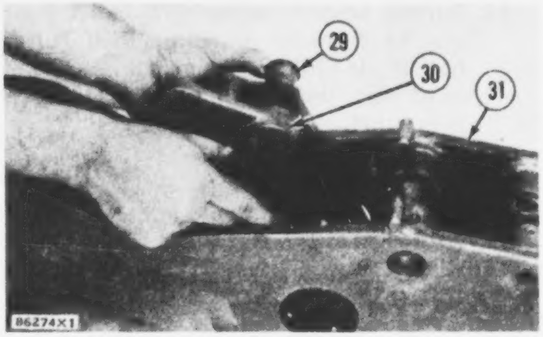
4. Install bearings (26) in lever (20) with tooling (4). Install bearings in the center bore of the lever with tooling (B). Install bearing (27) in the lever with tooling (C).

5. Put the holes in strut (24) and lever (20) in alignment and install pin (28) in the holes. Install washer (23) and cotter (21) on the pin. Put the holes in the brake toggle links (22) and the lever in alignment and install pin (25). Install snap ring (19) on the pin.

BRAKE HYDRAULIC CONTROLS & ACTUATING MECHANISMS

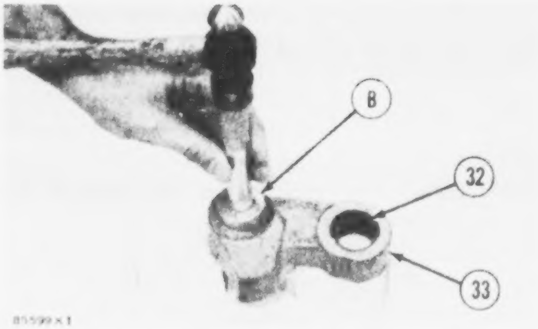
6. Fasten a hoist to support (31). Put the support in position over the assembled levers.

7. Put the holes in brake toggle links and brake link (30) in alignment. Install pin (29) in the holes. Install the snap ring that holds the pin.



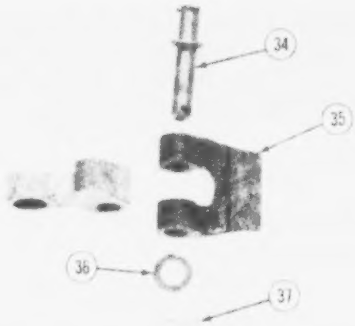
8. Install bearing (32) in lever (33) with tooling (C). Make sure the top of the bearing is .12 in. (3.0 mm) below the top face of the lever. Install the other bearing in lever (33) with tooling (B).

9. Put the holes in lever (33) and strut (35) in alignment. Install pin (34). Install washer (36) and cotter pin (37) that hold the pin.



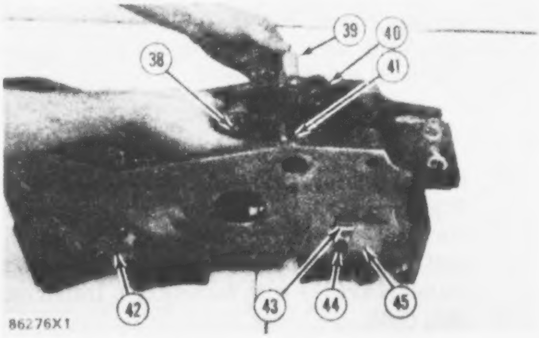
10. Put the hole in the center of lever (20) in alignment with the holes in the support. Install shaft (45). Install the bolts (44) and lock (43) that hold it.

11. Put the holes in levers (5) and (33) in alignment. Install shaft (42). Install the bolts and lock that hold it.



12. Install the bearing in bellcrank (40) with tooling (B).

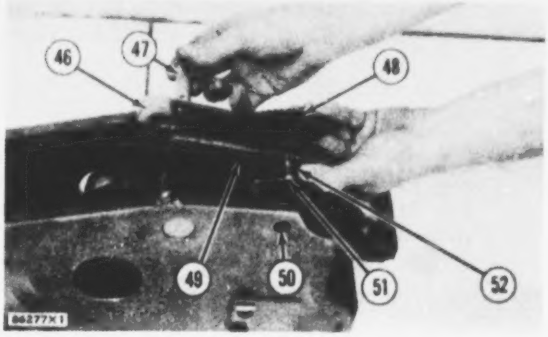
13. Put the holes in the bellcrank and brake link (30) in alignment. Install pin (38). Install the cotter pin that holds pin (38). Put the holes in the bellcrank and support in alignment. Install pin (39). Put the hole in the pin in alignment with hole (41). Install the pin that holds it.



BRAKE HYDRAULIC CONTROLS & ACTUATING MECHANISMS

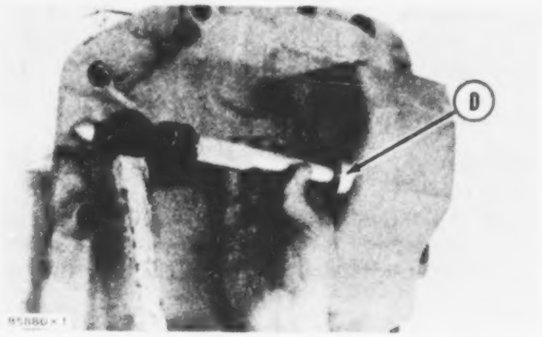
14. Put the holes in ratchet (48) and the support in alignment. Install pin (50). Put the hole in pin (50) in alignment with the hole in support. Install the pin that holds the pin in position.

15. Put the holes in links (49) and the ratchet in alignment. Install pin (51). Install pin (52).



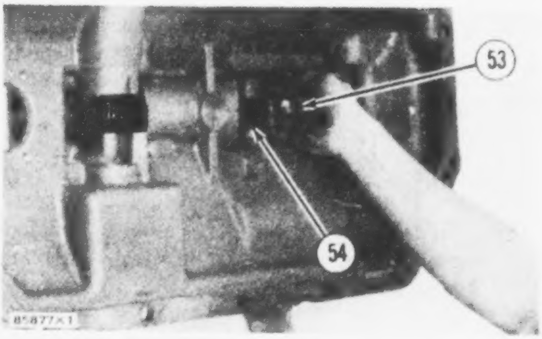
16. Put the holes in the bellcrank, links (49), and roller (46) in alignment. Install pin (47) and cotter pin.

17. Install the springs on the support and ratchet shaft.



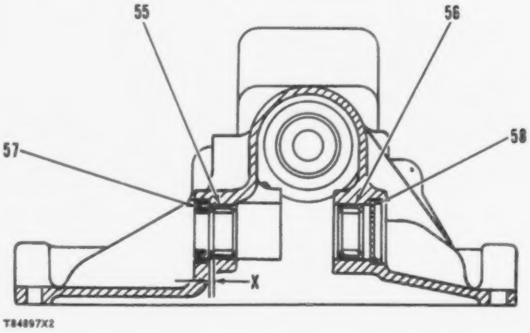
18. If the brake actuating mechanism has been assembled with new parts or any of the shims (4) behind the stop plate (3) have been lost, make an adjustment to the mechanism. See BRAKE ADJUSTMENTS in TESTING AND ADJUSTING.

19. Install the seal for the parking brake with tooling (D).



20. Install lever (53) and shaft (54) for the parking brake. Put the hole in the lever in alignment with the hole in the shaft. Install the pin through the holes.

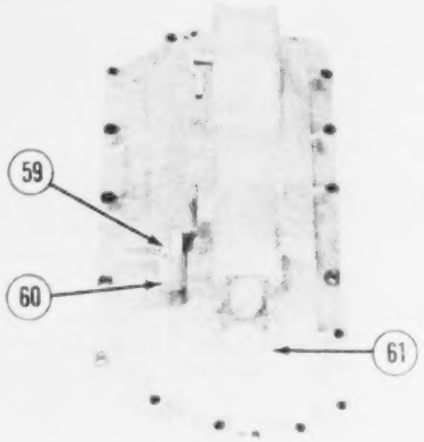
21. Install bearing (55) with tooling (C) until dimension (X) is .06 in. (1.52 mm) below the inside face of the bore in the cover. Install bearing (56) to the same dimension. Install seal (57) with tooling (E). Install cap plug (58).



BRAKE HYDRAULIC CONTROLS & ACTUATING MECHANISMS

22. Install sleeve (69) with tooling (F) until it is even with the bottom of its bore.
23. Install piston (70) with the passages (71) as shown.
24. Install the inner spring (68), out spring (67), plunger (66), and retainer (65).
25. Put roller (64) in position on lever (77) Install the pin (63) and cotter pin that holds it.
26. Slide brake control shaft (75) in the housing enough to install key (74). Put the groove (slot) in lever (77) in alignment with the key and completely install the shaft. Tighten nut (76).
27. Install brake control lever (60) and tighten the bolt (59).
28. Pull back on the brake control lever and install spring (72), stop (73), and cover (62).
29. Install the access cover (61) for brake adjustment.

end by:
   a) install brake hydraulic controls and actuating mechanisms



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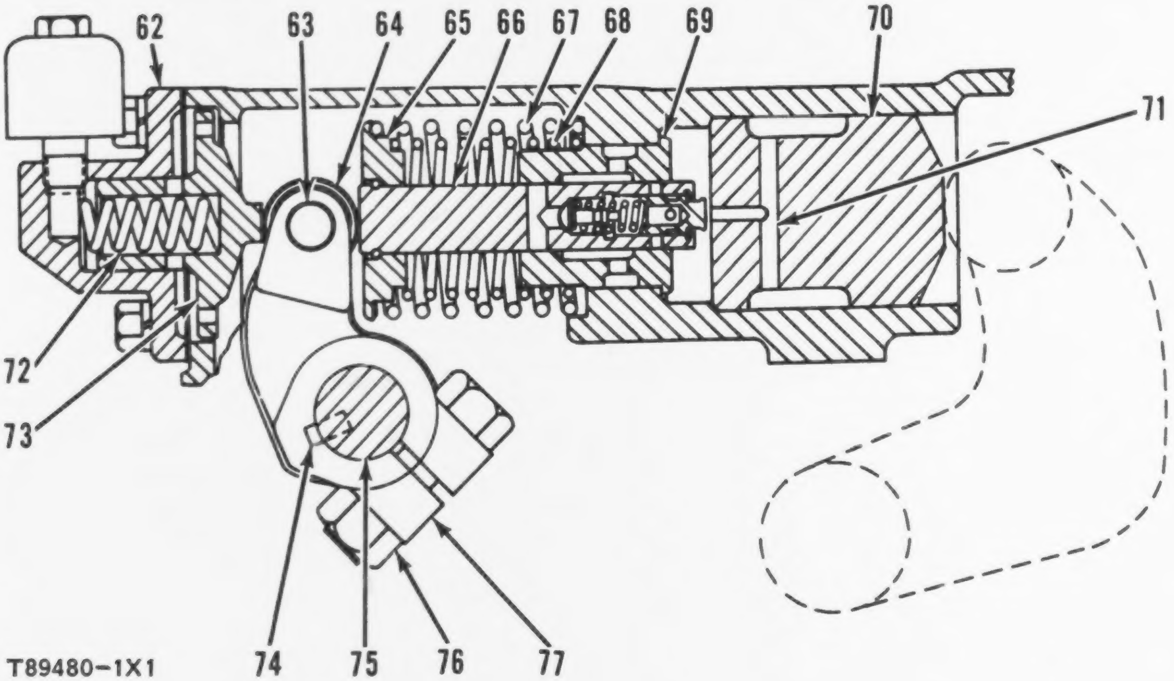

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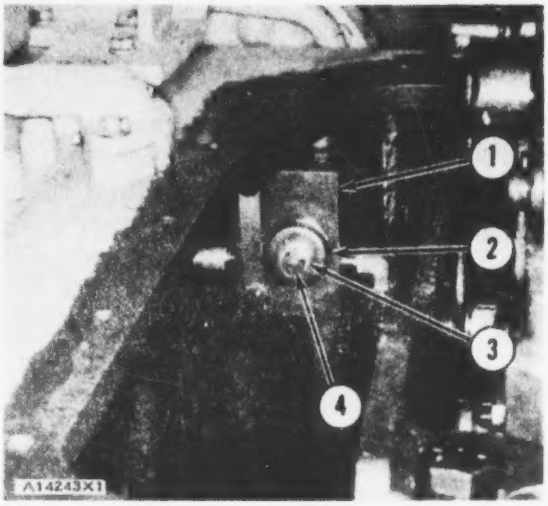
BRAKE COOLING AND LUBRICATION RELIEF VALVE

REMOVE BRAKE COOLING AND LUBRICATION RELIEF VALVE

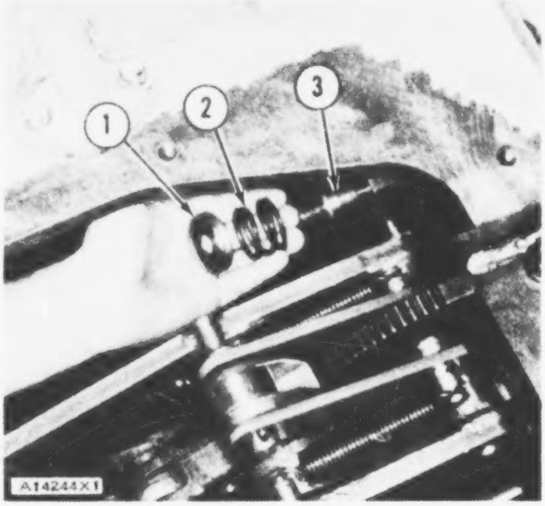


start by:
a) remove brake hydraulic control and actuating mechanism (right side of machine)

1. Remove nut (4), washer (3), spring retainer (2), spring and the valve from block (1).

2. Make sure the parts of the brake cooling and lubrication valve are clean and free of dirt and foreign material. If parts have wear and are damaged, use new parts for replacement.

INSTALL BRAKE COOLING AND LUBRICATION RELIEF VALVE



1. Put clean SAE 30 oil on valve (3). Install the valve in the block.

2. Install spring (2), spring retainer (1) the washer and nut.

end by:
a) install brake hydraulic control and actuating mechanism (right side of the machine)

STEERING CLUTCHES

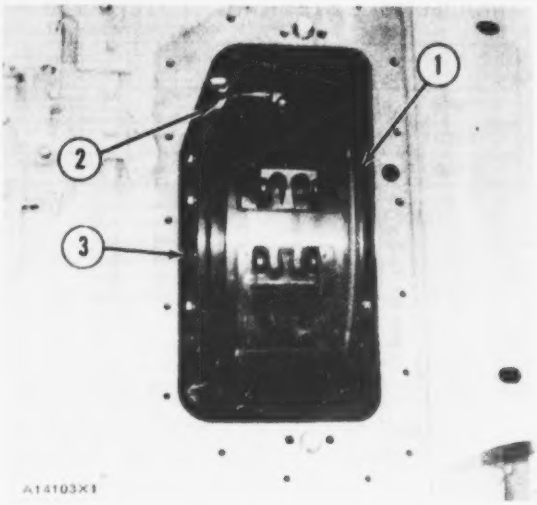
REMOVE STEERING CLUTCHES 11–4101

start by:
  a) remove brake hydraulic controls and actuating mechanisms

1. Disconnect one end of oil line (2). Keep the other end fastened to the brake band.

2. Remove bolts (3) from each side of the steering clutch. Turn the steering clutch 180°. Remove the other bolts that hold the steering clutch to the flange for the final drive pinion except for one on each side of the steering clutch.

3. Install two .38 in. (9.7 mm) diameter rods, 6 in. (152 mm) long, through the holes in the brake band. Fasten a hoist to the rods. Remove the two bolts from the steering clutch. Move the outer drum of the steering clutch away from the flange for the final drive pinion with a bar. Remove the steering clutch (1). Weight is 400 lb. (181 kg).



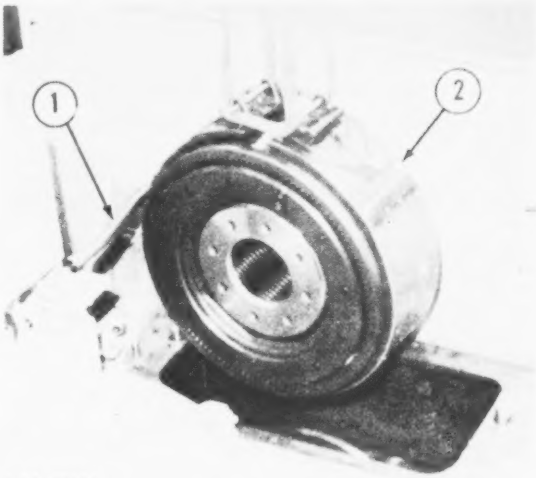
INSTALL STEERING CLUTCHES 12–4101

1. Install two .38 in. (9.7 mm) diameter rods, 6 in. (152 mm) long, through the holes in the brake band. Fasten a hoist to the rods. Put the steering clutch (2) in position between the steering clutch hub and flange for final drive pinion.

2. Put 4S9416 Anti-Seize Compound on the threads of the bolts that hold the steering clutches in position. Put one flange in alignment and loosely install one bolt. Turn the steering clutch 180°. Install one more bolt that holds the outer drum to the flange. Install the other bolts that hold the steering clutches. Tighten the bolts to a torque of 200 ± 20 lb.ft. (27.7 ± 2.8 mkg).

3. Connect oil line (1) to the bevel gear case.

end by:
  a) install brake hydraulic controls and actuating mechanisms

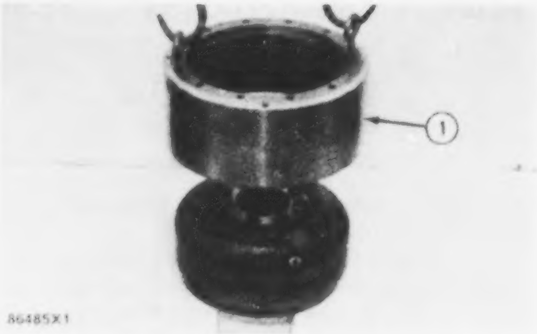


STEERING CLUTCHES

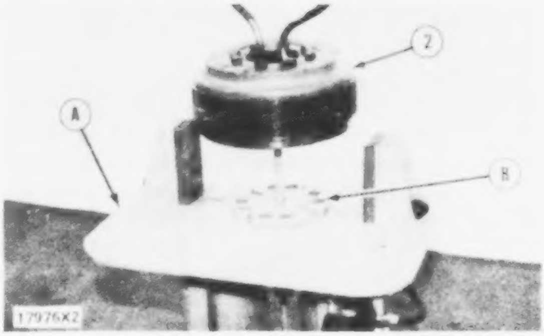
DISASSEMBLE STEERING CLUTCHES 15–4101

Tools Needed		A	B	C
FT610	Steering Clutch Stand	1		
5F5034	Plate		1	
5F5096	Plate			1

start by:
a) remove steering clutches

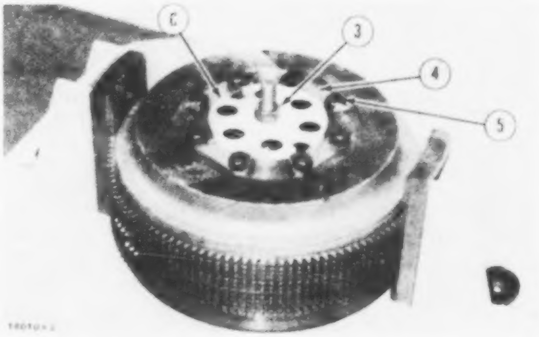


1. Remove the brake band from the outer drum.



2. Install two 5/8"–11 NC forged eyebolts in the outer drum. Fasten a hoist to the drum. Remove outer drum (1). Weight of the outer drum is 90 lb. (41 kg).

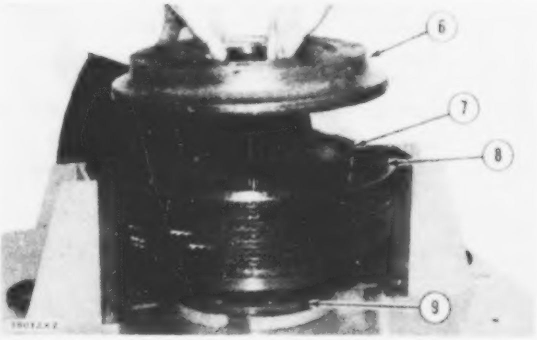
3. Install tool (B) over the stud on tool (A). Fasten a hoist to steering clutch (2) and install it over the stud on tool (A).



4. Install tool (C) and nut (3) over the stud.

5. Put enough force on the steering clutch to put the springs under compression. Remove bolts (5) and locks (4).

6. Release the compression from the springs. Remove nut (3), tool (C) and pressure plate (6).

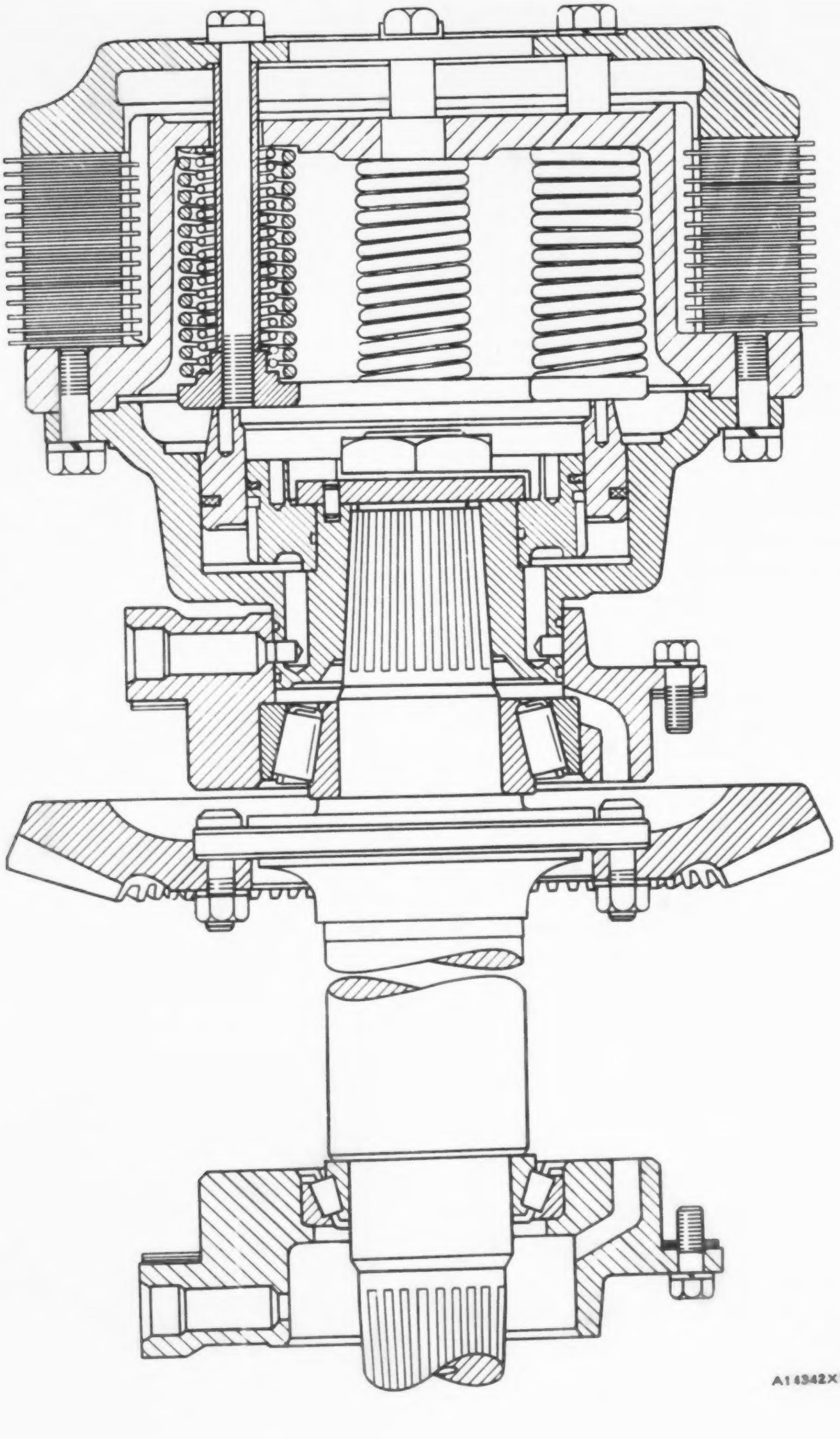


7. Remove sixteen disc assemblies (8) and fifteen discs from the inner drum.

8. Fasten a hoist to inner drum (7) and remove it.

9. Remove the eight outer springs, inner springs, sleeves and retainer (9).

STEERING CLUTCHES



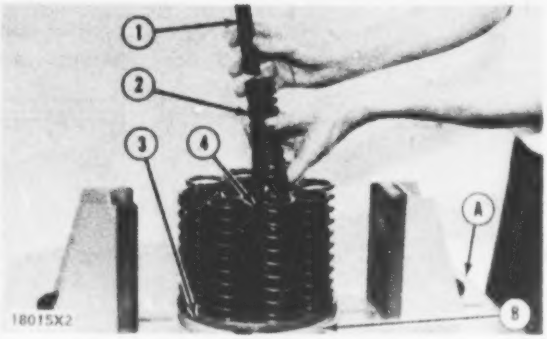
STEERING CLUTCHES

ASSEMBLE STEERING CLUTCHES 16–4101

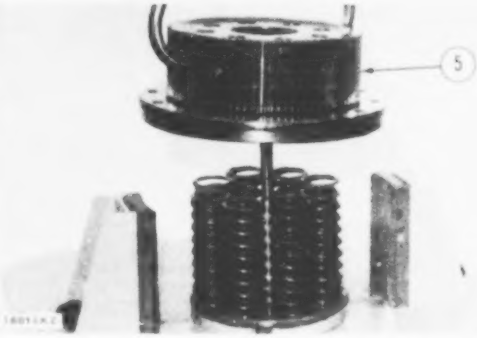
Tools Needed		A	B	C
FT610	Steering Clutch Stand	1		
5F5034	Plate		1	
5F5096	Plate			1

1. Put tool (B) and retainer (3) over the stud on tool (A).

2. Put sleeves (1) into inner springs (2). Put the sleeves and inner springs into outer springs (4). Install the springs and sleeves over the bosses on the retainer.



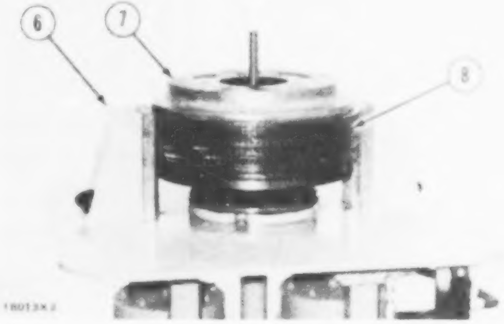
3. Fasten a hoist to the inner drum (5). Install it over the stud on the springs. Make sure the springs are in alignment with the holes in the inner drum.



4. Install sixteen disc assemblies starting with a disc assembly. Make sure there is a disc between each disc assembly. Put the disc aligners (6) in position to keep the splines of the disc assemblies in alignment.

5. Install pressure plate (7). Make sure the holes in the pressure plate and the inner drum are in alignment.

6. Install tool (C) and the nut on the stud.

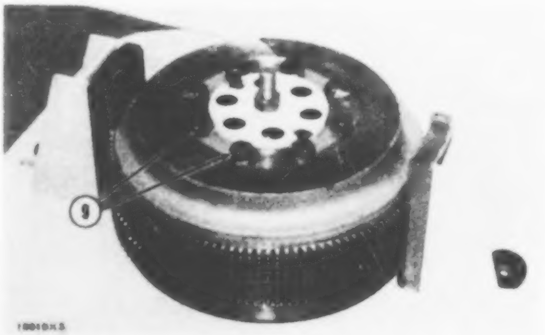


7. Put enough force on the steering clutch to put the springs under compression. Put 4S9416 Anti-Seize Compound on the threads of bolts (9). Install the bolts and locks.

8. Release the compression from the springs and remove the nut and tool (C).

9. Fasten a hoist to the steering clutch and remove it from tool (A).

10. Fasten a hoist to the outer drum. Put the splines of the outer drum in alignment with the disc assembly. Install the outer drum on the steering clutch.

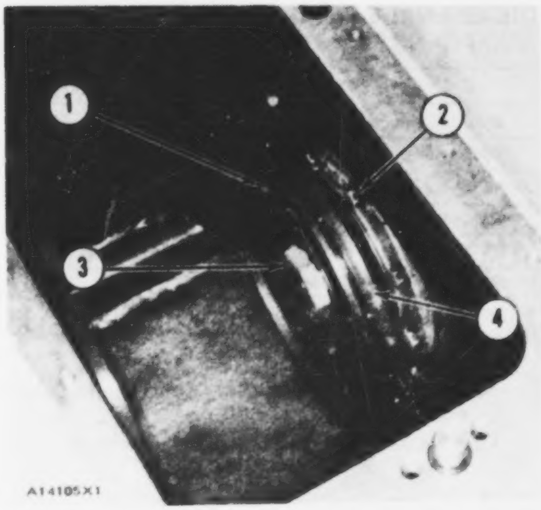


11. Install the brake band over the outer drum so the oil line will be to the front when installed.

end by:
  a) install steering clutches

FINAL DRIVE PINIONS AND FLANGES

REMOVE FINAL DRIVE PINIONS AND FLANGES 11–4091 & 4057



start by:
a) remove steering clutches

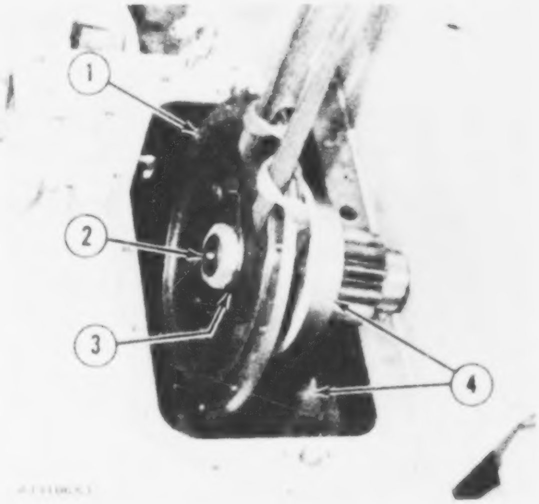
1. Loosen nut (3) if the final drive pinion and flange are to be disassembled.

2. Put the holes (1) in the flange in alignment with bolts (2). Remove the bolts. The flange must be turned to remove some of the bolts.

3. Put the holes in the flange in alignment with the forcing screw holes in the bearing cage. Install two 1/2"–13NC forcing screws. Tighten the forcing screws evenly until the bearing cage is free of the bevel gear case.

4. Fasten a hoist to the final drive pinion and flange (4) as a unit and remove it. Weight of the unit is 100 lb. (45 kg).

INSTALL FINAL DRIVE PINIONS AND FLANGES 12–4091 & 4057



1. Remove the old gasket material from the surfaces (4) that seal for the bearing cage and bevel gear case. Put 7M7260 Liquid Gasket Material on the surfaces.

2. Fasten a hoist to the final drive pinion and flange (1) as a unit. Put the unit in position in the bevel gear case. Make sure the teeth of the final drive pinion and idler pinion gear are engaged. Make sure the pinion bearing race engages in its bearing.

3. Put the holes in the bearing cage and bevel gear case in alignment. Make sure the dowel in the bearing cage is up and oil passage is down. Install the bolts that hold the bearing cage to the bevel gear case. Tighten the bolts by hand to a torque of 100 ± 10 lb.ft. (13.8 ± 1.4 mkg). The final drive flange must be turned to install some of the bolts.

4. Tighten nut (2) and make a bend in lock (3) against the side of the nut.

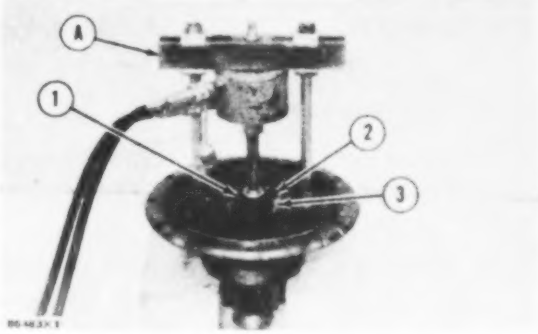
end by:
a) install steering clutches

FINAL DRIVE PINIONS AND FLANGES

DISASSEMBLE FINAL DRIVE PINIONS AND FLANGES 15–4091 & 4057

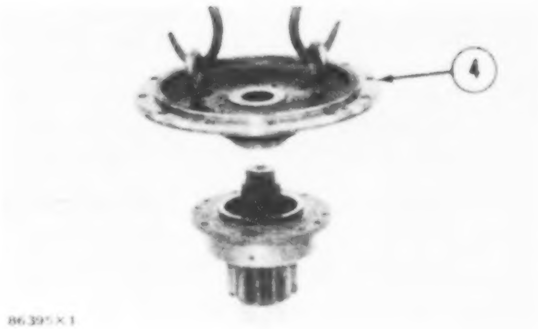
Tools Needed		A	B
9S5800	Pump Group	1	
1S4233	Puller Group	1	
8B7548	Puller Assembly	1	1
5F7341	Adapter	2	
8B7561	Step Plate	1	1
8B7551	Bearing Pulling Attachment		1
8H684	Ratchet Box Wrench		1

start by:
a) remove final drive pinions and flanges

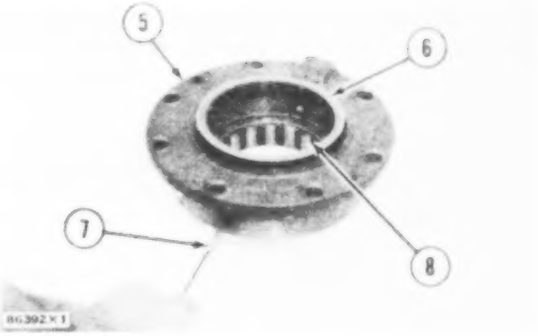


1. Loosen nut (1) approximately .50 in. (12.7 mm).

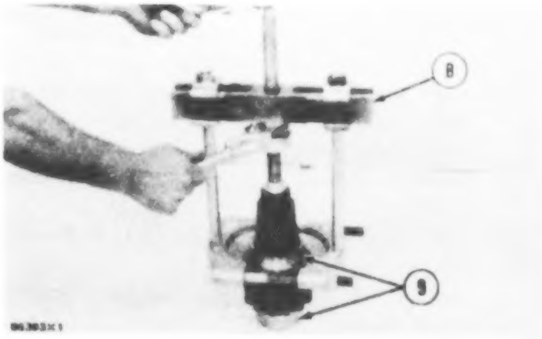
2. Install tooling (A) on the flange. Put enough force on the flange to loosen it from the pinion.



3. Remove tooling (A), nut (1), bolt (2), lock (3), and a gasket.



4. Fasten a hoist to the final drive flange (4) and remove it. Remove the Duo-Cone seal from the flange. Weight of the flange is 45 lb. (20 kg).



5. Remove bearing cage (5) from the pinion. Remove Duo-Cone seal (6) from the bearing cage. Remove dowel (7) from the bearing cage with a 10–24NC screw. Remove bearing (8).

6. Remove the bearing races (9) from each end of the pinion with tooling (B).

FINAL DRIVE PINIONS AND FLANGES

ASSEMBLE FINAL DRIVE PINIONS AND FLANGES

16–4091 & 4057

Tools Needed		A	B
5S4275	Seal Installer	1	
1S4233	Puller Group		1
9S5800	Pump Group		1
6H1627	Spacer		1
1M6763	Adapter		1
1S6560	Bolt		1

1. Heat the pinion bearing races in oil to a temperature of 275°F (135°C). Install the races (5) on each end of pinion.

2. Lower the temperature of bearing (3) and install it in the bearing cage. Put the hole in the bearing in alignment with the hole in the bearing cage. Install dowel (4). Install the bearing cage (2) on the pinion.

3. Install the Duo-Cone seals (1) in the bearing cage and the final drive flange with tool (A).

NOTE: Make sure that the Duo-Cone seals and all metal surfaces that are in contact with the seals are clean and dry at assembly. Put a small amount of oil between the metal surfaces of the seals before installing.

4. Fasten a hoist to the final drive flange (6) and put it in position on the pinion.

CAUTION: Make sure the splines of the flange and pinion are in alignment and that they are clean and dry.

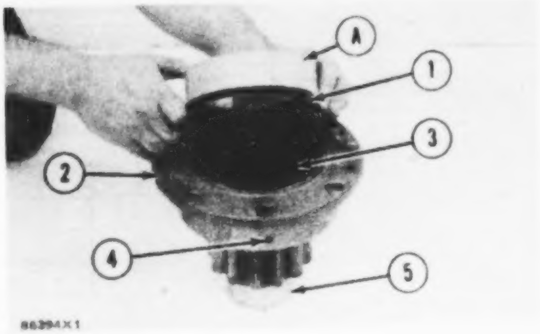
5. Install tooling (B) on the pinion shaft. Put between 35 to 40 tons (31.8 to 36.3 t) of force on the flange.

6. Remove tooling (B) and measure the distance between the face of the flange and shoulder of the pinion shaft. The distance must be .12 ± .03 in. (3.0 ± 0.8 mm).

7. Install the gasket, lock (7), bolt (9), and nut (8).

NOTE: Tighten the nut after the unit is installed in the tractor.

end by:
  a) install final drive pinion and flange as a unit



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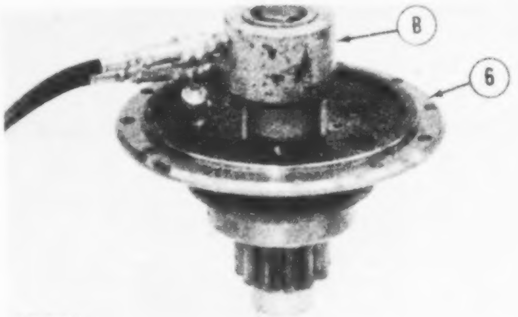

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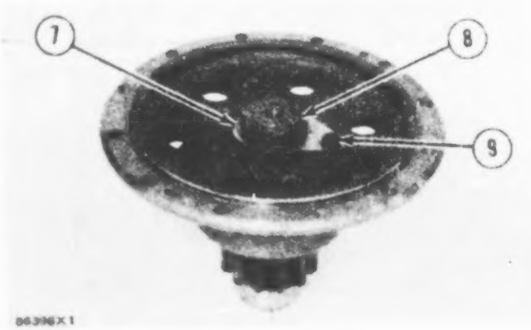

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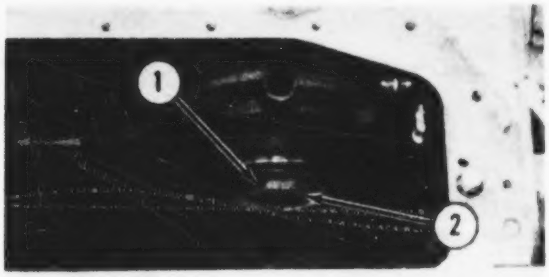
STEERING CLUTCH HUBS

REMOVE STEERING CLUTCH HUBS 11–4101

Tools Needed		A	B
1P2321	Puller Assembly	1	
S1618	Bolt	2	
1M6764	Puller		1
1S4233	Puller Group		1
8B7548	Puller Assembly		1
1D4624	Bolt		2
1B4367	Bolt		4
9S5800	Pump Group		1

start by:
a) remove steering clutches

1. Remove nut (2) and lock (1).



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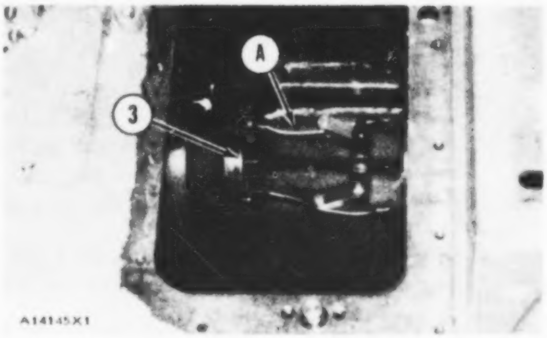
2. Install tooling (A) on pilot (3) for the steering clutch piston. Remove the pilot, piston and washer as a unit.



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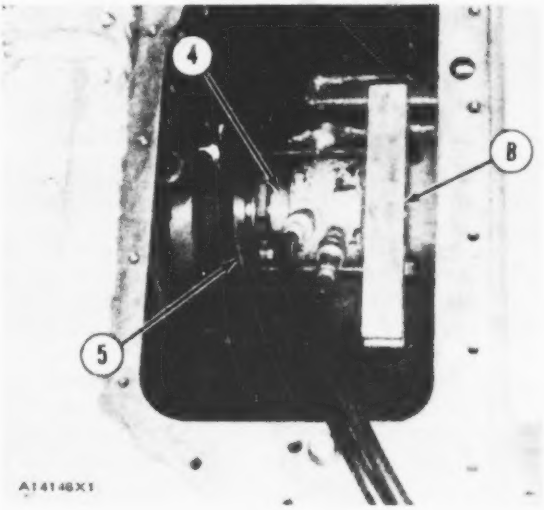
3. Install nut (2) back on the bevel gear shaft. Install the nut even with the end of the bevel gear shaft.

4. Install tooling (B) and a spacer (4) 1.375 in. (34.9 mm) in diameter and 1.750" (44.5 mm) long as shown.

5. Put enough force on the steering clutch hub to remove it from the bevel gear shaft. Remove tooling (B) and the spacer.

6. Fasten a hoist to the steering clutch hub. Remove nut (2). Remove steering clutch hub (5). Weight of the steering clutch hub is 55 lb. (25 kg).



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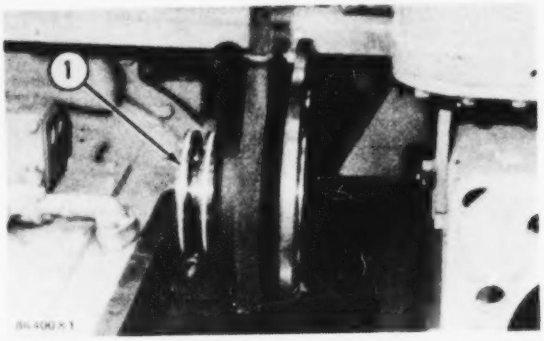
STEERING CLUTCH HUBS

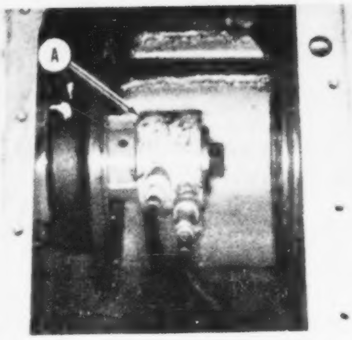
INSTALL STEERING CLUTCH HUBS 12–4101

Tools Needed		A
1S4233	Puller Group	1
6H1627	Spacer	1
8F1156	Bolt	1
1M6763	Adapter	1
3H467	Washer	1

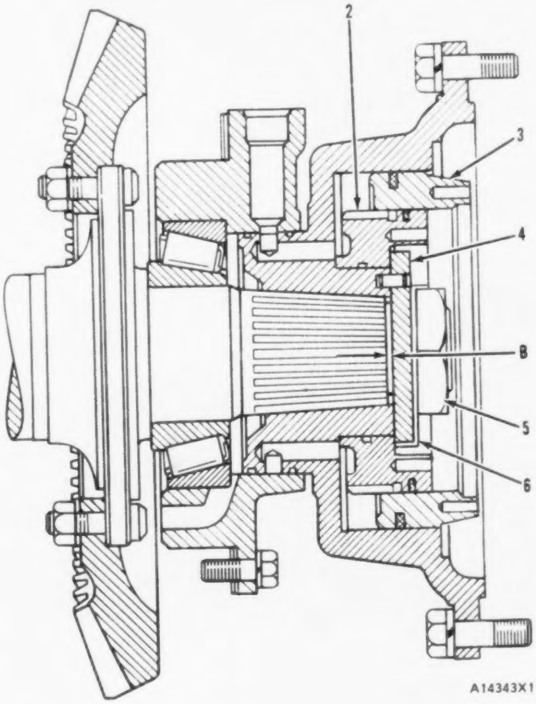


1. Fasten a hoist to the steering clutch hub (1). Put the hub in position on the bevel gear shaft.

NOTE: Make sure the splines in the hub and on the bevel gear shaft are clean and dry.



2. Install the washer for the steering clutch hub. Install tooling (A) as shown. Push the hub in position on the bevel gear shaft with a force of 35 to 40 tons (31.8 to 36.3 t). Remove tooling (A) and the washer.



3. Measure distance (B) between the shoulder on the bevel gear shaft and the face of the hub. Distance (B) must be .12 ± .03 in. (3.0 ± 0.8 mm).

4. Put piston (3) into pilot (2). Install the piston and pilot as a unit in the steering clutch hub.

5. Put the dowel in washer (4) in alignment with the hole in the steering clutch hub. Install the washer.

6. Install lock (6) and nut (5).

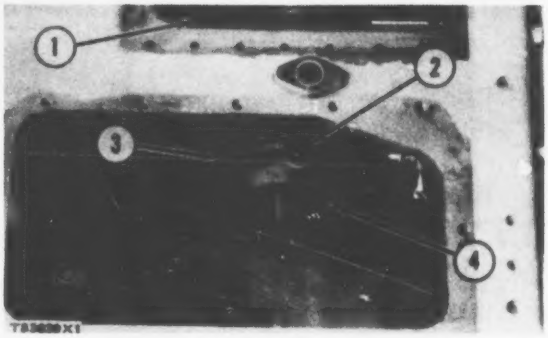
end by:
a) install steering clutches

BEVEL GEAR AND SHAFT

REMOVE BEVEL GEAR AND SHAFT 11–3256

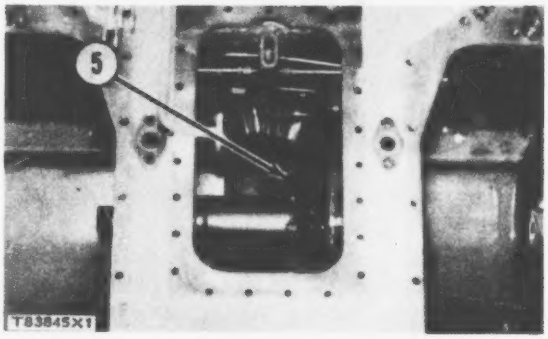
start by:
- a) remove steering clutch hydraulic control valve
- b) remove steering clutch hubs

1. Remove the cover from the bevel gear compartment (1).



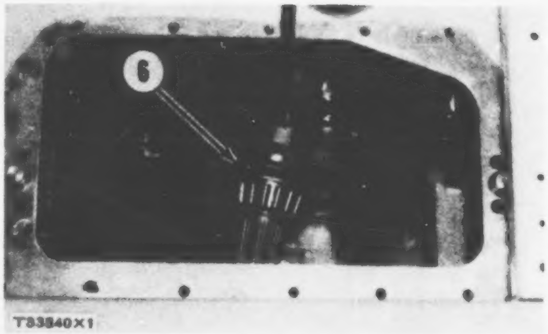
2. Remove oil lines (2) from each hub.

3. Fasten a hoist to the bevel gear shaft for use as a support.



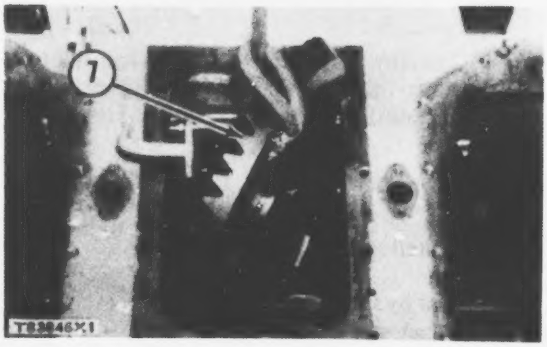
4. Remove the bolts from each bearing cage (3). Install two 1/2"–13NC forcing screws (4) in the bearing cage. Tighten the forcing screws evenly until the bearing cage is free of the bevel gear case.

5. Remove nuts (5), bolts, and locks that hold the shaft to the gear.



6. Move the bevel gear shaft (6) into the steering clutch compartment on the right. Fasten a hoist to the bevel gear shaft and remove it. Weight is 80 lb. (36 kg).

7. Fasten a hoist to the bevel gear (7) and remove it from the bevel gear compartment. Weight is 57 lb. (26 kg).



BEVEL GEAR AND SHAFT

INSTALL BEVEL GEAR AND SHAFT 12–3256

	Tools Needed	A
7H1942	Indicator	1
7H1948	Snug	1
7H1940	Attachment	1
7H1645	Rod	1

NOTE: A bearing adjustment for the bevel gear shaft can be made with the transmission in or out of the machine. A more specific preload can be put on the bearings with the transmission out of the machine. The following procedure is for putting preload on the bevel gear bearings for a power shift or direct drive machine with the transmission removed. See BEVEL GEAR AND PINION (POWER SHIFT) or BEVEL GEAR AND PINION (DIRECT DRIVE) in TESTING AND ADJUSTING for putting preload on the bevel gear bearings with the transmission in the machine.

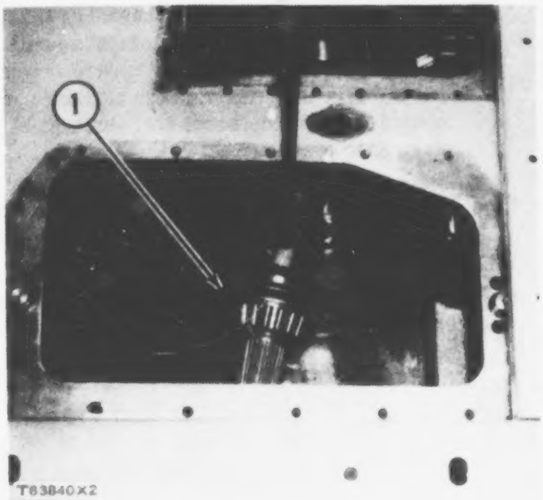
1. Fasten a hoist to the bevel gear shaft (1). Put the shaft into position through the steering clutch compartment on the right side. Move the shaft to the left through the bearing cage bore.

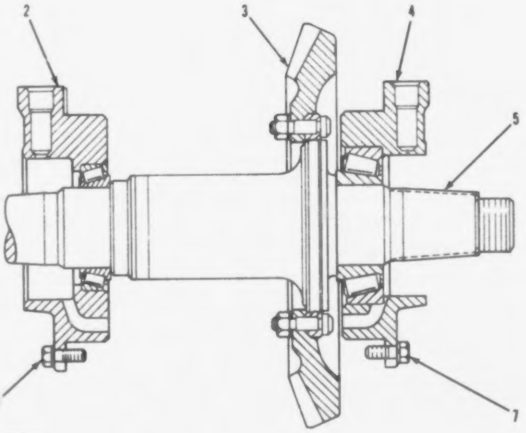
NOTE: Install the bevel gear shaft (5) without the bevel gear (3) unless the transmission has been removed.

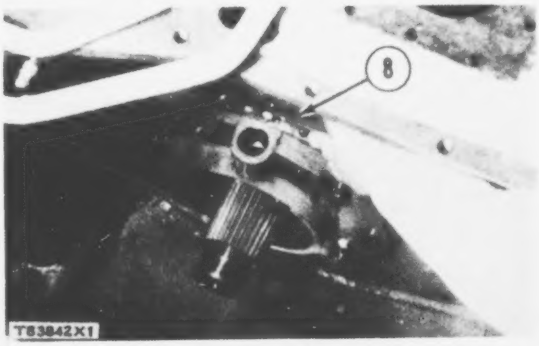
2. Install the right bearing cage (4) with a full package of shims. Install the bolts (7) that hold the bearing cage. Tighten the bolts evenly.
3. Install the left bearing cage (2) without shims. Install two bolts (6) without lockwashers, 180° apart. Tighten the bolts evenly while slowly turning the shaft until a torque of 60 to 80 lb.in. (69.2 to 92.2 cm.kg) is needed to turn the shaft.

NOTE: To find the torque needed to turn the bevel gear shaft, weld a strap of metal across the nut for the steering clutch hub. Weld a small nut in the center of the strap. Install the nut and strap on the end of the bevel gear shaft. Put a torque wrench on the small nut.

4. Measure the distance between the left bearing cage and the face of the bevel gear case with a feeler gauge. Make a measurement at the location of both bolts. Make sure the distance is the same all around the bearing cage.



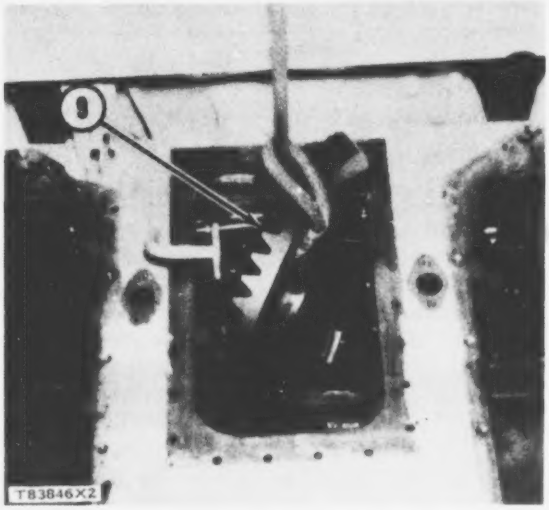


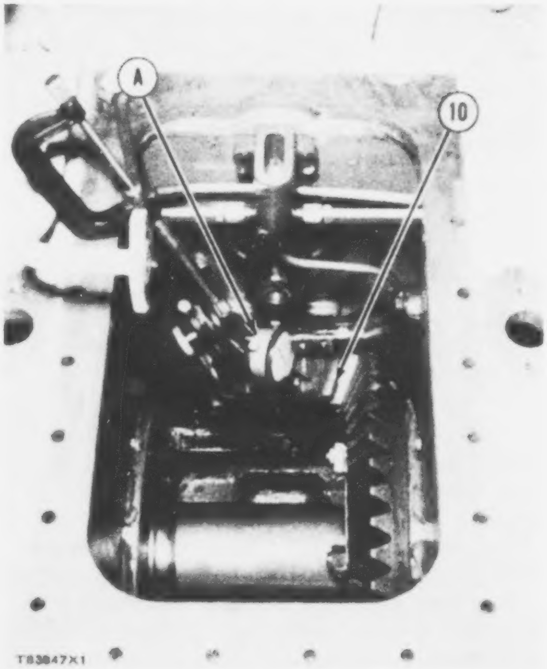


BEVEL GEAR AND SHAFT

5. Remove the left bearing cage. Install an amount of shims with the same thickness as the measurement in Step 4. Install the left bearing cage and its bolts. Check the torque needed to turn the bevel gear shaft again to make sure that it is between 60 to 80 lb.in. (69.2 to 92.2 cm.kg).
6. Remove the right bearing cage. Move the bevel gear shaft into the compartment for the right steering clutch. Fasten a hoist to the bevel gear (9). Put it in position in the bevel gear compartment. Move the bevel gear shaft to the left through the bevel gear. Install the bolts and locks that hold the bevel gear and shaft together.
7. Put the right bearing cage and its shims in position and install the bolts that hold it.
8. Make a check for the gear clearance (backlash) between the bevel gear and bevel pinion as follows:
   a) Put a block of wood between the bevel gear case and bevel gear so the bevel gear can not turn.
   b) Install tooling (A) on one tooth of the bevel pinion (10). Push the bevel pinion as far forward as it will go. Turn the bevel pinion from one side to the other. The gear clearance (backlash) is the difference read on the dial indicator. Check the gear clearance (backlash) at four points around the bevel gear to find the point of smallest gear clearance (backlash). The correct gear clearance (backlash) for the power shift machine is .025 –.003 or +.004 in. (0.64 –0.08 or +0.10 mm). The correct gear clearance (backlash) for the direct drive machine is .0115 –.003 or +.004 in. (0.29 –0.08 or +0.10 mm).
   c) If the smallest gear clearance (backlash) measurement is too large, remove the shims from the right bearing cage. Put the shims on the left bearing cage. To make the gear clearance (backlash) larger, move the shims from the left bearing cage to the right bearing cage.

NOTE: The preload on the bearings for the bevel gear shaft will not change by moving the shims from one bearing cage to the other if the total thickness of shims is the same.





BEVEL GEAR AND SHAFT

NOTE: It is not necessary to check tooth contact setting on power shift machines.

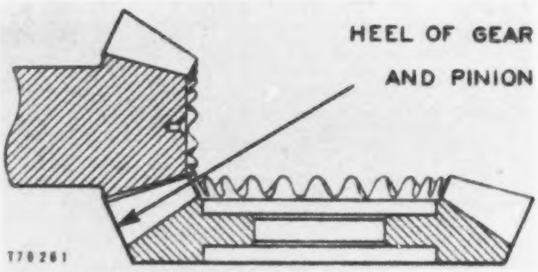
9. After the gear clearance (backlash) and bearing preload adjustments have been made, check tooth contact setting between bevel gear and pinion (on direct drive machines only) as follows:
   a) Put a small amount of Prussian blue, red lead, or paint on the bevel gear teeth. Turn pinion and check marks made on bevel gear teeth.
   b) With no load, correct tooth contact setting will be as shown. The area of contact starts near toe of gear and goes about 30% up the length of tooth. With this setting, when load is put on gear, it will be over the correct area of the teeth.
   c) If bevel pinion shaft is too far away from bevel gear, short toe contact will be the result as shown. The teeth of pinion will be in contact with toe ends of convex faces (parts that make curves toward the outside), and top edges of heel ends of concave faces (parts that make curves toward the inside). To correct this, move pinion shaft toward gear by making a decrease of shim thickness between pinion cage and transmission front cover. After doing this, check gear clearance (backlash) and tooth contact again.
   d) If bevel pinion shaft is too near to center of bevel gear, short heel contact will be the result as shown. The teeth of pinion will be in contact with toe ends of concave faces (parts that make curves toward the inside) and the heel ends of convex faces (parts that make curves toward the outside). To correct this, move pinion away from gear by making an increase of shim thickness between pinion cage and carrier. After doing this, check gear clearance (backlash) and tooth contact again.

NOTE: Several adjustments of both pinion and bevel gear can be necessary before correct tooth contact setting and gear clearance (backlash) are made. Always remember that a change to gear clearance (backlash) will also change the tooth contact setting. Therefore, be sure the gear clearance (backlash) is in correct adjustment before checking the tooth contact.

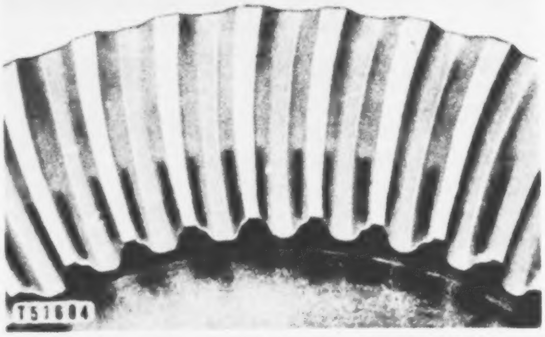
   e) After correct gear clearance (backlash) and tooth contact setting are made, remove extra Prussian blue, red lead, or paint from the bevel gear and pinion.

end by:

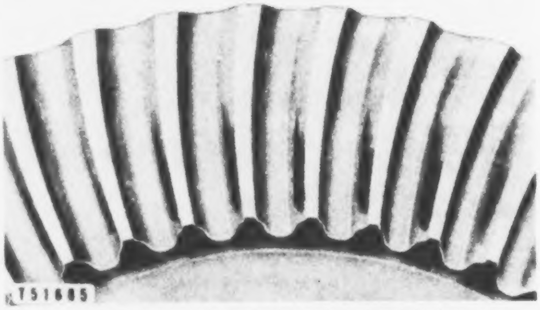
   a) install steering clutch hubs
   b) install steering clutch hydraulic control valve



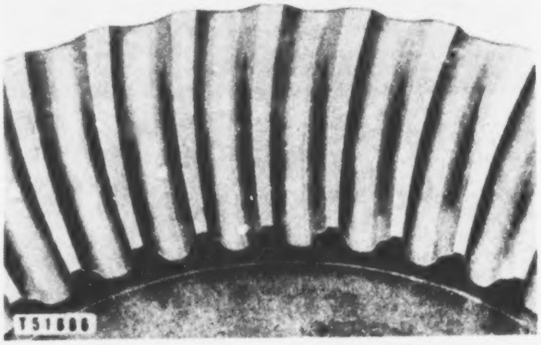
ALIGNMENT OF BEVEL GEAR AND PINION



CORRECT TOOTH CONTACT SETTING



SHORT TOE CONTACT SETTING

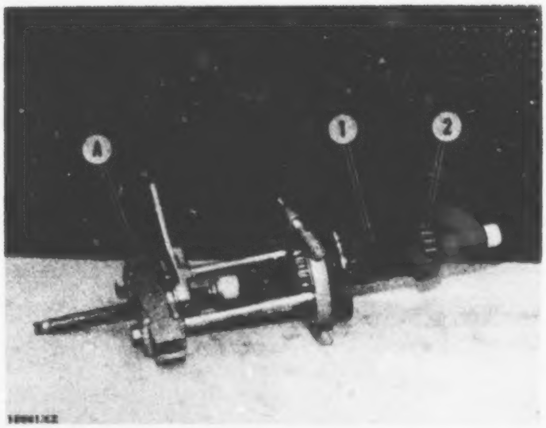


SHORT HEEL CONTACT SETTING

BEVEL GEAR SHAFT BEARINGS

REMOVE BEVEL GEAR SHAFT BEARINGS 11–3257

	Tools Needed	A
8B7548	Puller Assembly	1
8B7560	Step Plate	1
8H684	Ratchet Box Wrench	1
8B7551	Bearing Pulling Attachment	1



start by:
a) remove bevel gear and shaft

1. Remove the bearing cones (2) from the bevel gear shaft with tooling (A).

2. Remove the bearing cups from the bearing cages.

INSTALL BEVEL GEAR SHAFT BEARINGS 12–3257

1. Heat the bearing cones for the bevel gear shaft in oil to a maximum temperature of 275°F (135°C). Install the bearing cones on the shaft.

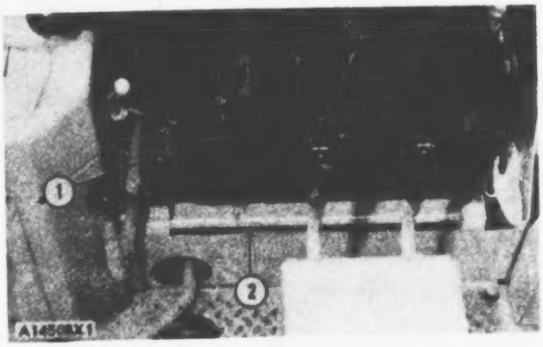
2. Lower the temperature of the bearing cups for the bearing cages. Install the bearing cups in their respective bearing cages.

end by:
a) install bevel gear shaft

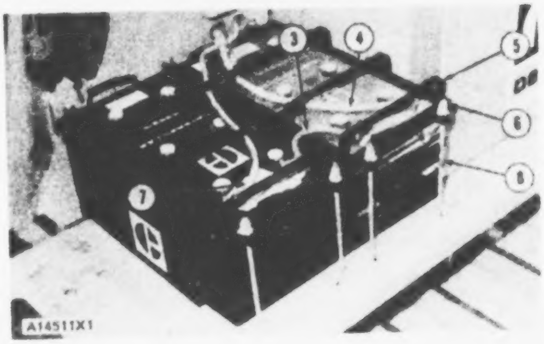
SEAT AND SEAT FRAME ASSEMBLY

REMOVE SEAT AND SEAT FRAME ASSEMBLY 11–7321

Tools Needed		A
9S9155	Spacer	1
5F7465	Puller Assembly	1
9S9152	Bearing Puller	1
5S9603	Bolt	2
5M2894	Washer	2

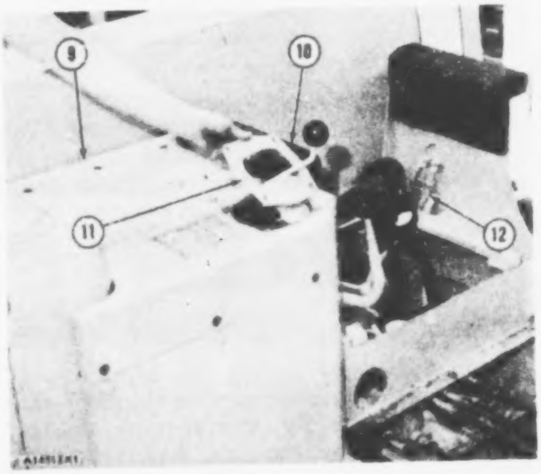


1. Fasten a hoist to seat (1) and release latch (2) that holds the seat. Remove the seat. Weight of the seat is 60 lb. (27 kg).



2. Remove the cover from over the batteries. Disconnect battery cables (3), (4) and (7). Remove nuts (6) and rods (8). Remove bracket (5) that holds the batteries to the fender. Remove the batteries with a hoist. Weight of each battery is 160 lb. (73 kg).

3. Remove the floor plates.



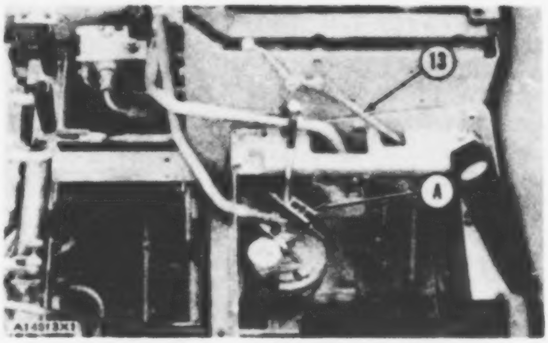
4. Remove the bolts that hold the cover for the hydraulic controls (if so equipped).

5. Remove plate (11), boot, cover (9) and cushion (10) (if so equipped).

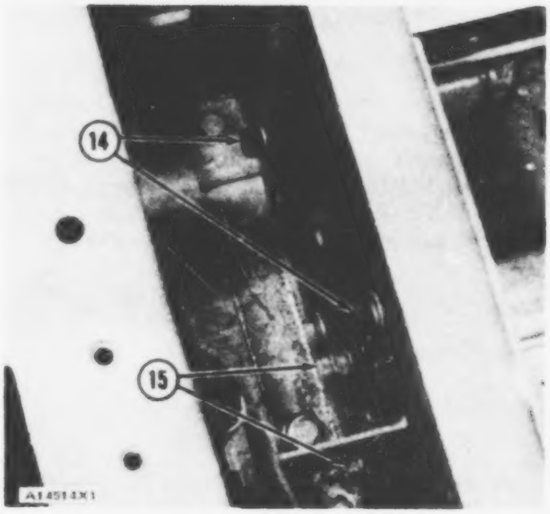
6. Disconnect the two cables (12) from the disconnect switch. Put identification on the cables to prevent mixing at assembly.

SEAT AND SEAT FRAME ASSEMBLY

7. Remove the nut from over the selector control lever. Remove the selector control lever with tooling (A).

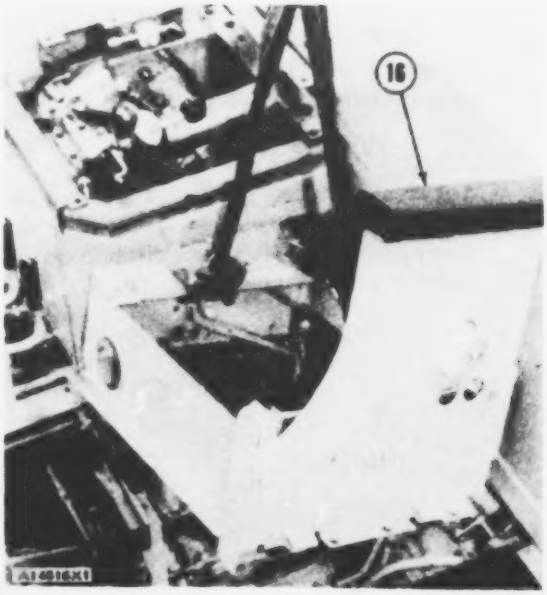


8. Disconnect rod (13) at the parking brake lever.



9. Remove six bolts (14) that hold the seat frame assembly to the side panel for the hydraulic controls and the support for the seat frame assembly.

10. Remove three bolts (15) that hold the directional control lever in position. Remove the three bolts that hold the seat frame assembly to the left fender of the machine.



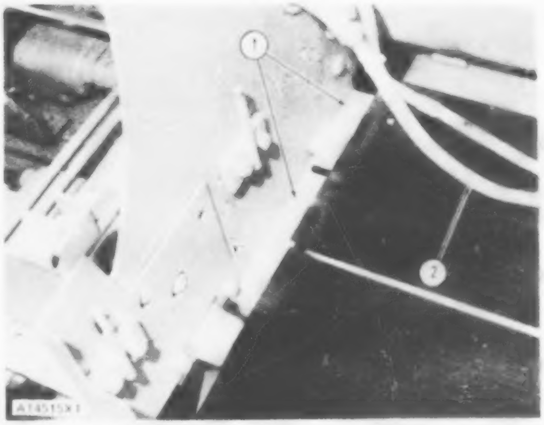
11. Fasten a hoist to the seat frame assembly (16). Remove the seat frame assembly. Weight of the seat frame assembly is 155 lb. (70 kg).

CAUTION: Do not cause damage to the battery cables when the seat frame assembly is removed.

SEAT AND SEAT FRAME ASSEMBLY

INSTALL SEAT AND SEAT FRAME ASSEMBLY 12–7321

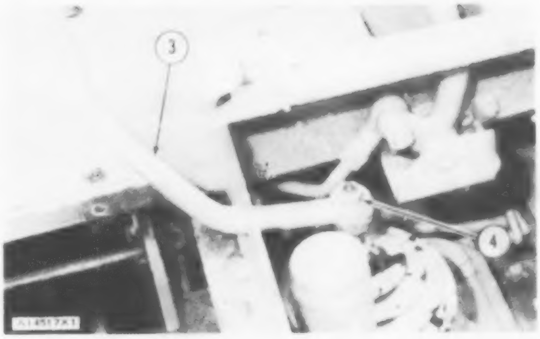
1. Fasten a hoist to the seat frame assembly. Put the seat frame assembly in position on the machine. Install three bolts (1) that hold the seat frame assembly to the fender. Install the six bolts that hold the seat frame assembly to the side panel for the hydraulic controls.



2. Put the two battery cables (2) through the holes in the side of the seat frame assembly.

3. Put the directional control lever in position on the side panel for the hydraulic controls. Install the three bolts that hold it.

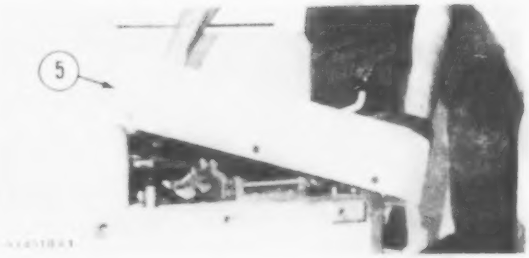
4. Connect the rod to the parking brake lever.



5. Install selector control lever (3). Install the nut (4) that holds it.

6. Connect the two battery cables to the disconnect switch.

7. Install the cushion on the seat frame assembly. Install cover (5). Install the bolts that hold it. Install the boot and plate over the hydraulic control lever.



8. Install the floor plates.

9. Put the batteries in the correct position on the fender of the machine. Install the bracket and rods that hold the batteries in position.

10. Connect the three battery cables to the batteries.

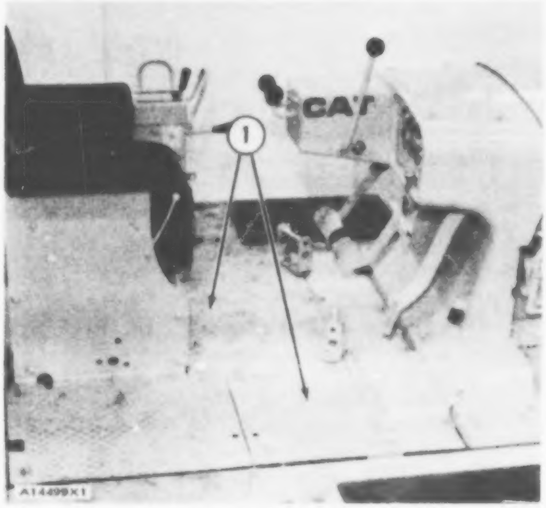
11. Install cover (6).

12. Fasten a hoist to the seat. Put the seat in position on the seat frame assembly. Connect the latch that holds the seat in position.

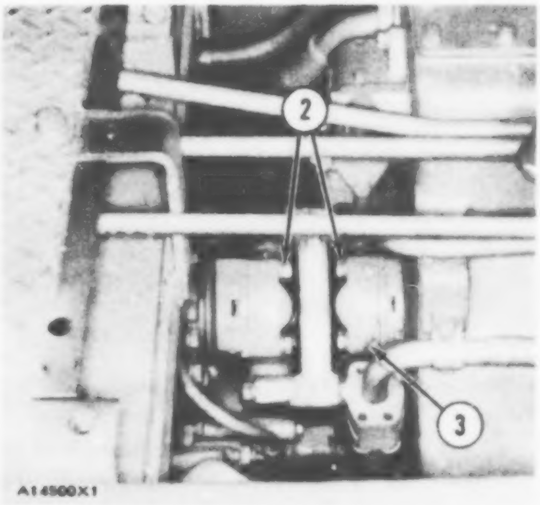
UNIVERSAL JOINT (POWER SHIFT)

REMOVE UNIVERSAL JOINT (POWER SHIFT) 11–3251

1. Remove floor plates (1) from above the universal joint.



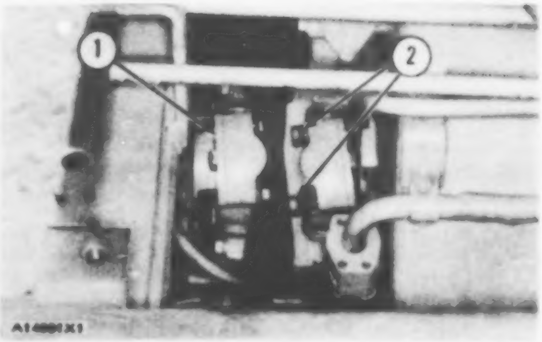
2. Fasten a hoist to the universal joint. Remove bolts (2) that hold the universal joint in position.



3. Remove universal joint (3). Weight of the universal joint is 50 lb. (23 kg).

INSTALL UNIVERSAL JOINT (POWER SHIFT) 12–3251

1. Put bolts (2) in position in the universal joint. Fasten a hoist to the universal joint.
2. Put the universal joint (1) in position between the transmission and torque divider.
3. Tighten bolts (2) to a torque of 100 ± 5 lb.ft. (13.8 ± 0.7 mkg).
4. Install the floor plates above the universal joint.

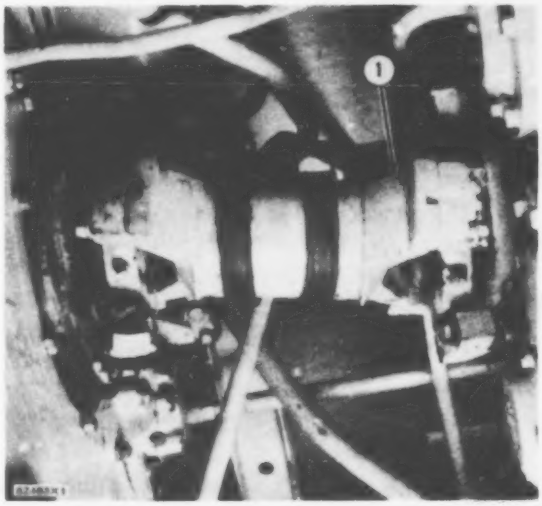


UNIVERSAL JOINT (DIRECT DRIVE)

REMOVE UNIVERSAL JOINT (DIRECT DRIVE) 11–3251

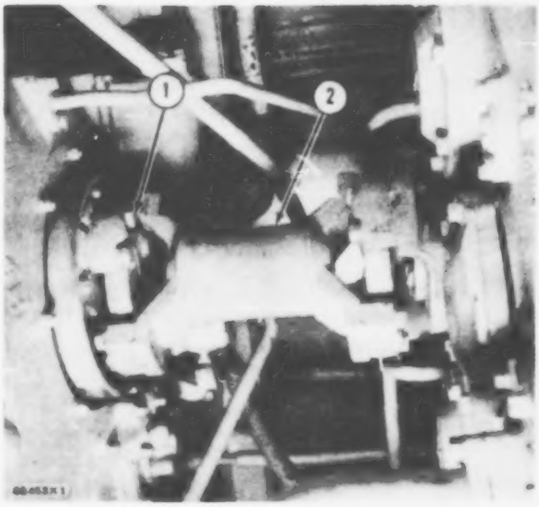
NOTE: Photos shown are from the bottom of the machine for better illustration.

1. Remove the floor plates from above the universal joint.
2. Fasten a hoist to the universal joint. Remove the bolts that hold the universal joint to the flywheel clutch and transmission.
3. Remove the universal joint (1). Weight is 50 lb. (23 kg).



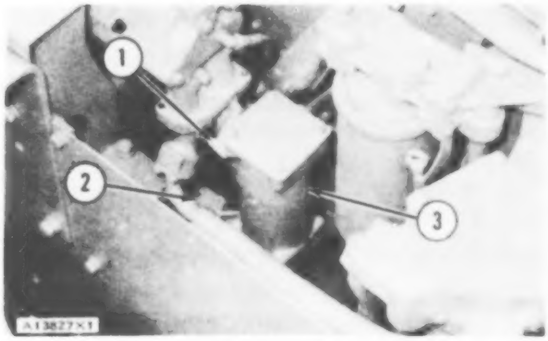
INSTALL UNIVERSAL JOINT (DIRECT DRIVE) 12–3251

1. Fasten a hoist to the universal joint (2) and put it in position between the flywheel clutch and transmission.
2. Install bolts (1) that hold it. Tighten the bolts to a torque of 100 ± 10 lb.ft. (13.8 ± 1.4 mkg).
3. Install the floor plates above the universal joint.

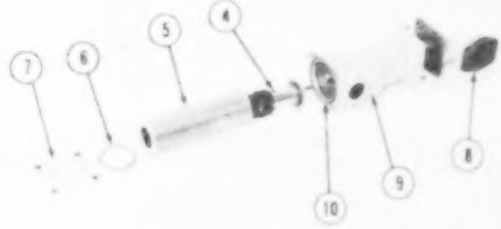


TRANSMISSION MAGNETIC SCREEN

REMOVE TRANSMISSION MAGNETIC SCREEN 11–3179



1. Remove two bolts (1).
2. Disconnect oil supply line (2).
3. Remove transmission magnetic screen (3).



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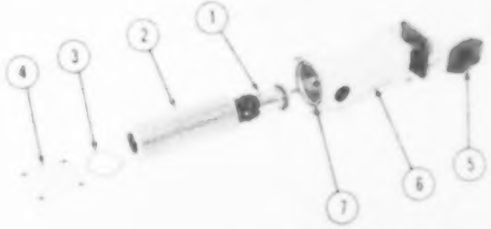
4. Remove cover (7) and seal (10) from housing (9). Remove spring washer (6), element (5) and magnet (4) from the housing.
5. Remove manifold (8) and the seal from the housing.

INSTALL TRANSMISSION MAGNETIC SCREEN 12–3179



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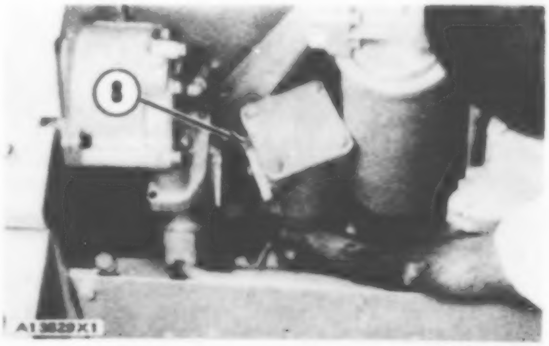
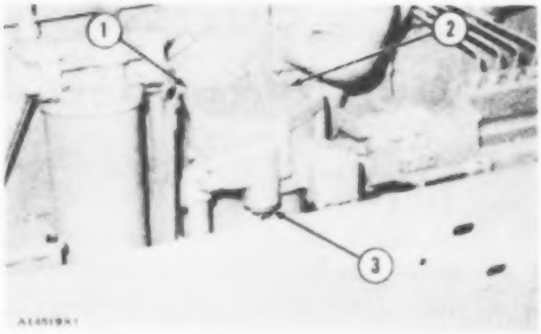
1. Make sure all of the parts of the transmission magnetic screen are clean and free of dirt and foreign material.
2. Install manifold (5) and the seal on housing (6). Install magnet (1) in the housing. Install a new element (2) in the housing. Put seal (7) in position in the housing. Put clean SAE 30 oil on the seal. Install spring washer (3) and cover (4) on the housing.



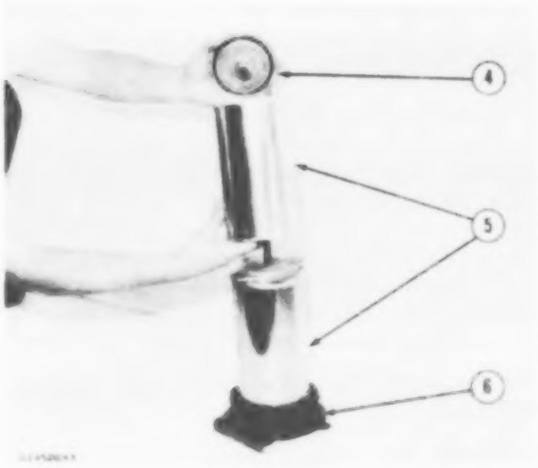
3. Put the transmission magnetic screen in position on the flange as shown. Install the two bolts that hold the transmission magnetic screen (8) in position. Connect the oil supply line to the bottom of the transmission magnetic screen.

TRANSMISSION OIL FILTER

REMOVE TRANSMISSION OIL FILTER 11–3179

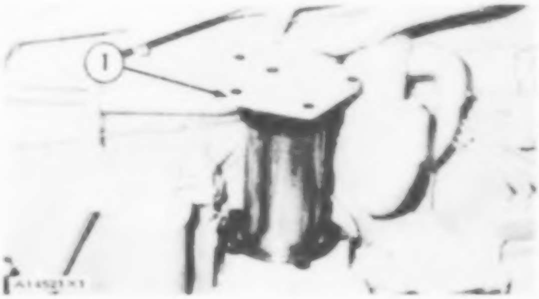


1. Remove bolts (1) from the cover assembly.
2. Remove cover assembly (2) and filters from the housing assembly.

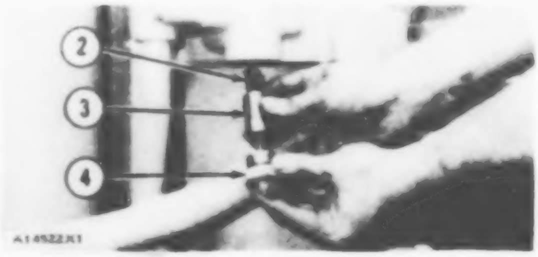


3. Remove plug (3), the spool and spring from the cover assembly.
4. Remove the nut, retainer (4) and two filters (5) from the cover assembly.
5. Check the O-ring seals (6) on the retainer and cover assembly for damage. If the O-ring seals have damage, use new parts for replacement.

INSTALL TRANSMISSION OIL FILTER 12–3179



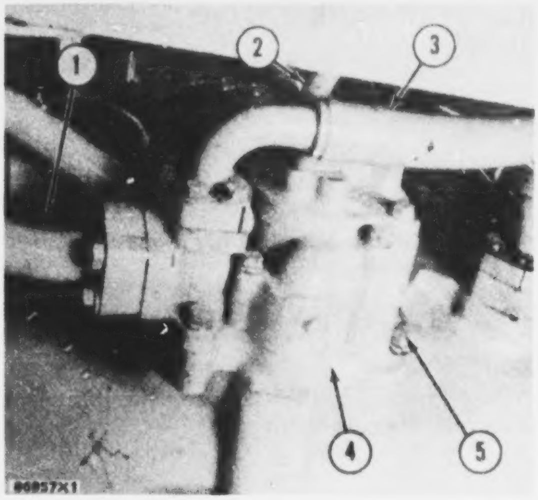
1. Install two new filters on the cover assembly. Put new O-ring seals on the retainer and cover assembly. Install the retainer and nut that holds the filters in position. Tighten the nut to a torque of 10 ± 2 lb.ft. (1.4 ± 0.3 mkg).



2. Install cover assembly (1). Install the bolts that hold it.
3. Install spring (2), spool (3) and plug (4) in the cover assembly.

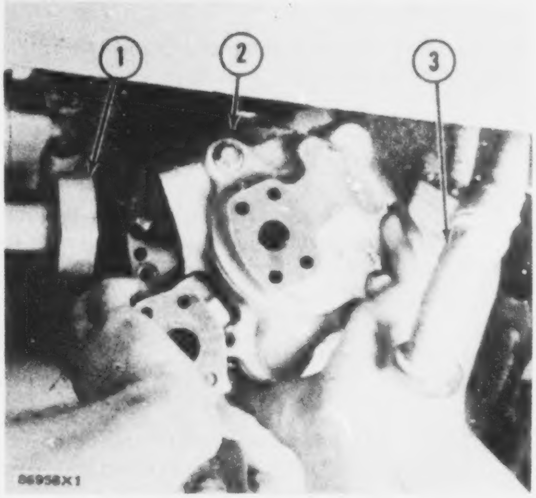
TORQUE DIVIDER SCAVENGE & CIRCULATING OIL PUMP (POWER SHIFT)

REMOVE TORQUE DIVIDER SCAVENGE AND CIRCULATING OIL PUMP (POWER SHIFT) 11–3115



1. Remove the oil from the torque divider and transmission.
2. Disconnect the oil supply line (2) for brake cooling from the pump.
3. Disconnect the oil supply line (3) for the transmission lubrication from the pump.
4. Disconnect the oil return line (1) for the transmission oil cooler from the pump.
5. Remove bolts (5).
6. Install two 3/8"–16NC forcing screws in the pump. Remove the scavenge and circulating pump (4) for the torque divider.

INSTALL TORQUE DIVIDER SCAVENGE AND CIRCULATING OIL PUMP (POWER SHIFT) 12–3115



1. Put the scavenge and circulating pump (2) for the torque divider in position on the torque divider. Install the bolts that hold it.
2. Connect the oil return line (1) to the pump. Connect the two oil supply lines (3) to the pump.
3. Fill the torque divider and transmission with oil to their correct levels.

TORQUE DIVIDER SCAVENGE & CIRCULATING OIL PUMP (POWER SHIFT)

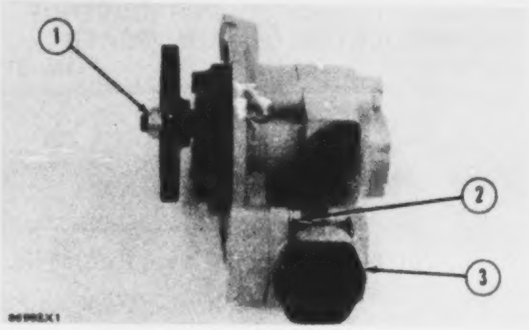
DISASSEMBLE TORQUE DIVIDER SCAVENGE AND CIRCULATING OIL PUMP (POWER SHIFT) 15–3115

	Tools Needed	A
1P2321	Puller Assembly	1

start by:

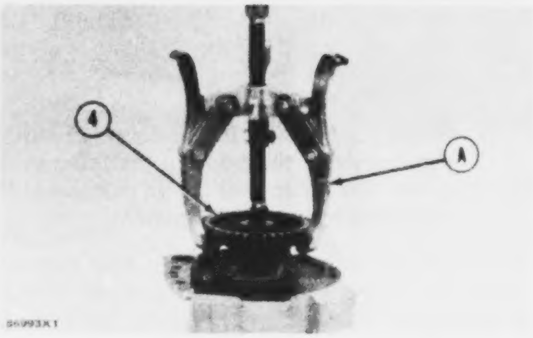
a) remove torque divider scavenge and circulating oil pump

1. Remove the bolts (2) and adapter (3).



2. Remove the nut (1).

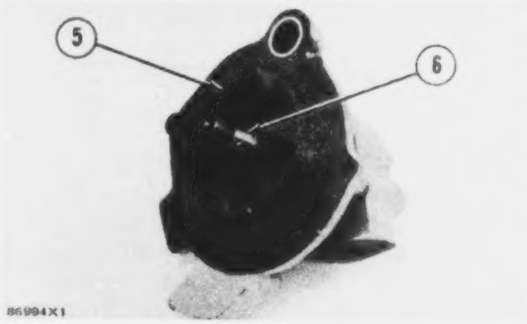
3. Remove the gear (4) with tool (A).



4. Remove the key (6). Remove the bolts (5) that hold the pump together.

5. Remove the cover (7) from the body (8). Remove the two gears (9).

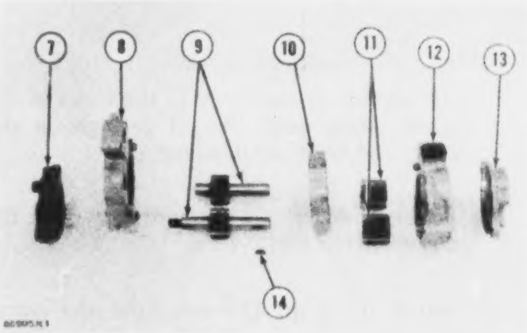
6. Remove the key (14) from the shaft of the gear.



7. Remove the cover (10).

8. Remove the two gears (11). Remove the body (12) from the cover (13).

9. Remove the bearings from covers (7) and (10).



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TORQUE DIVIDER SCAVENGE & CIRCULATING OIL PUMP (POWER SHIFT)

ASSEMBLE TORQUE DIVIDER SCAVENGE AND CIRCULATING OIL PUMP (POWER SHIFT) 16–3115

	Tools Needed	A
1P529	Handle	1
1P467	Drive Plate	1
1P461	Drive Plate	1

NOTE: Put a small amount of oil on all inner pump components before assembling.

1. Install the bearings for the gears in the two covers with tooling (A). The bearings must be .062 ± .010 in. (1.57 ± 0.25 mm) below the faces of the covers which are in contact with the body (4).

2. Install the body (4) on the cover (2) putting the dowels in the body in the holes in the cover. Make sure that the oil passages in the cover and body are in alignment.

NOTE: If the dowels in the body were removed, install the dowels so their outer faces are .19 ± .02 in. (4.8 ± 0.5 mm) from the outer faces of the body.

3. Install gears (10) and (14) in the body (4).

4. Install the gear (13) through the top bearing in the cover (5). Install the key (3).

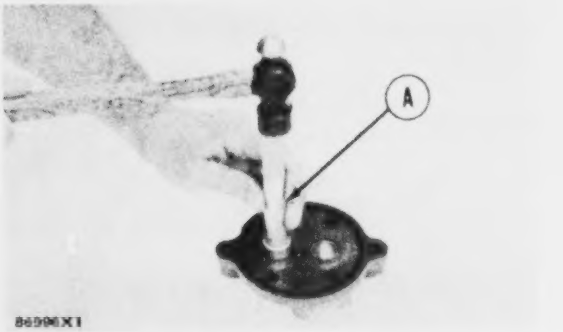
5. Put the cover (5) with the gear in position on the body (4). Make sure the key is in alignment with its groove in the gear. Make sure the dowels in the body are in alignment with their holes in the cover.

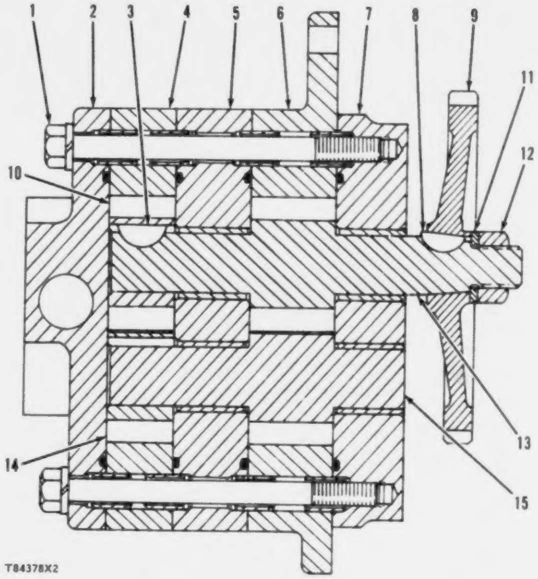
6. Install the gear (15) through the bearing in the cover (5).

7. Install the body (6) on the cover (5) putting the dowels in the body in the holes in the cover. Make sure the oil passages in the cover and body are in alignment.

8. Put the cover (7) in position over the dowels in the body (6).

9. Install the bolts (1) that hold the pump together.





10. Install key (8) in gear (13). Install gear (13). Install gear (9) over the key on gear (13). Install washer (11) and nut (12) on gear (13). Tighten the nut ot a torque of 85 ± 5 lb. ft. (11.8 ± 0.7 mkg).

NOTE: The pump must turn freely by hand after assembling.

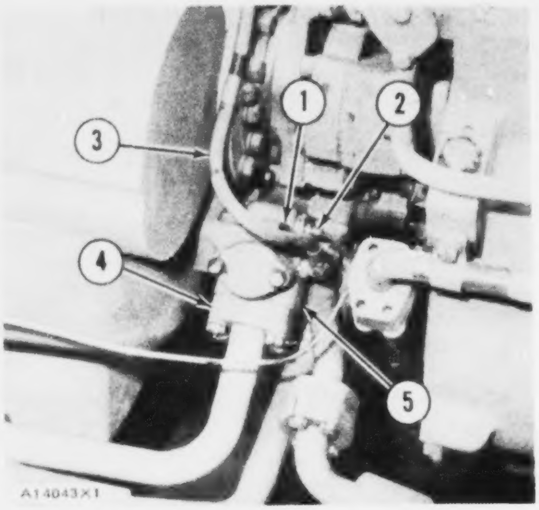
end by:
  a) install torque divider scavenge and circulating oil pump

TORQUE CONVERTER OUTLET RELIEF VALVE(POWER SHIFT)

REMOVE TORQUE CONVERTER OUTLET RELIEF VALVE (POWER SHIFT) 11–3100

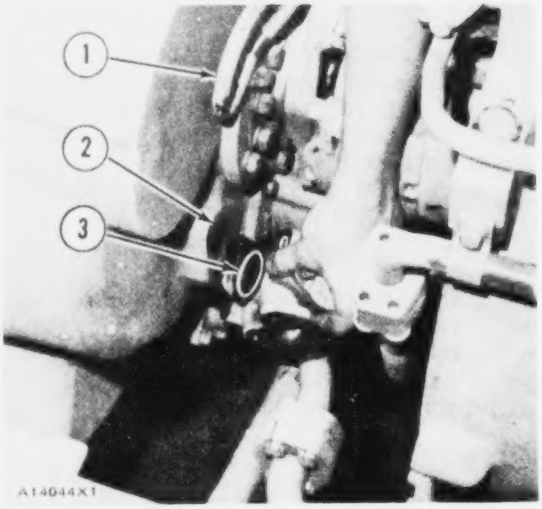
NOTE: The front crossmember is removed for better illustration of the torque converter outlet relief valve.

1. Drain the oil from the torque divider and the transmission.
2. Remove the floor plates.
3. Disconnect the oil temperature bulb and gauge line (2) from the relief valve.
4. Disconnect vent line (3) from the relief valve.
5. Disconnect oil outlet line (4) from the relief valve.
6. Remove bolts (1). Remove relief valve (5).
7. Remove the O-ring seal from the relief valve. If the O-ring seal has damage, use new parts for replacement.



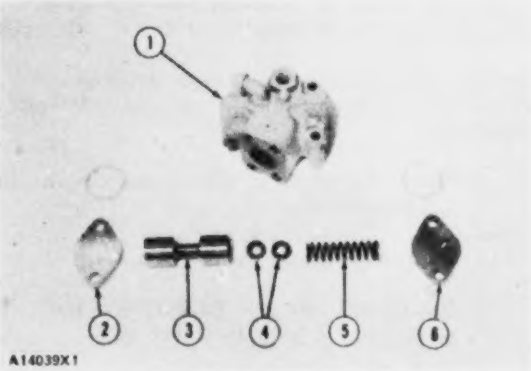
INSTALL TORQUE CONVERTER OUTLET RELIEF VALVE (POWER SHIFT) 12–3100

1. Install a new O-ring seal (3) in the relief valve. Put clean SAE 30 oil on the O-ring seal.
2. Put relief valve (2) in position on the torque divider. Install the bolts that hold it.
3. Connect vent tube (1) to the relief valve.
4. Connect the oil outlet line to the relief valve.
5. Connect the oil temperature bulb and gauge line to the relief valve.
6. Fill the transmission and torque divider with oil to the correct level. See LUBRICATION AND MAINTENANCE GUIDE.
7. Install the floor plates.



TORQUE CONVERTER OUTLET RELIEF VALVE(POWER SHIFT)

DISASSEMBLE TORQUE CONVERTER OUTLET RELIEF VALVE (POWER SHIFT) 15–3100



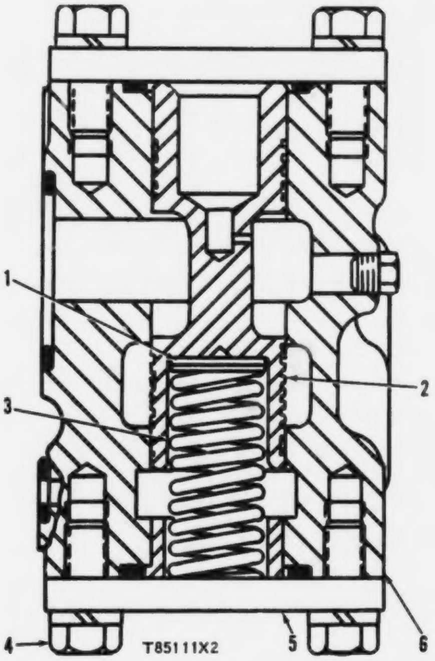
start by:
a) remove torque converter outlet relief valve

WARNING: Keep pressure on cover (6) when the bolts that hold it are removed.

1. Remove bolts and cover (6) from relief valve body (1).
2. Remove bolts and cover (2) from relief valve body.
3. Remove valve spool (3), spacers (4) and spring (5) from the relief valve body.

ASSEMBLE TORQUE CONVERTER OUTLET RELIEF VALVE (POWER SHIFT) 16–3100

1. Make sure all of the parts of the torque converter outlet relief valve are clean and free of dirt and foreign material. Put clean SAE 30 oil on the parts of the torque converter outlet relief valve.



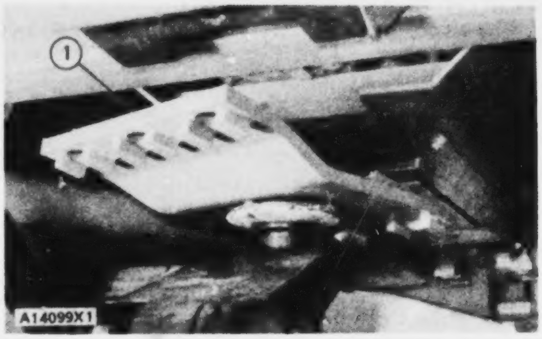
2. Put spring (3), spacers (1) and valve spool (2) in position in relief valve body (6). Install cover (5) and the bolts that hold it. Install the cover and bolts on the other side of the relief valve body.

NOTE: The spacers (1) are used to make an adjustment to the pressure needed to open the torque converter outlet relief valve. See POWER SHIFT TRANSMISSION TESTING AND ADJUSTING.

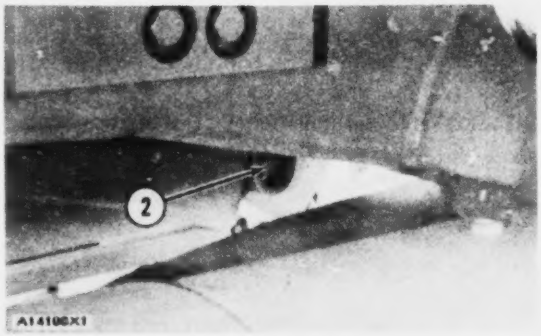
CRANKCASE GUARD (REAR)

REMOVE CRANKCASE GUARD (REAR) 11–7151

1. Put a floor jack in position under guard (1). Remove the six bolts that hold the guard in position. Lower the guard and remove it from under the machine. Weight of the guard is 105 lb. (48 kg).

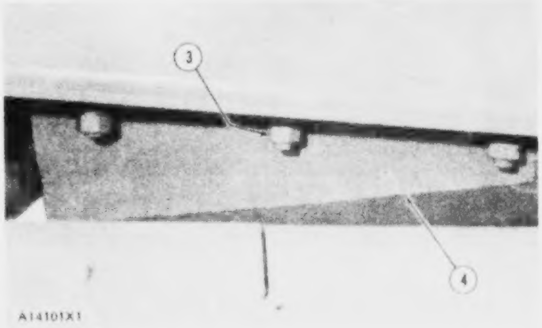


2. Remove two bolts (2) from the bracket on each side of the crankcase guard (rear).

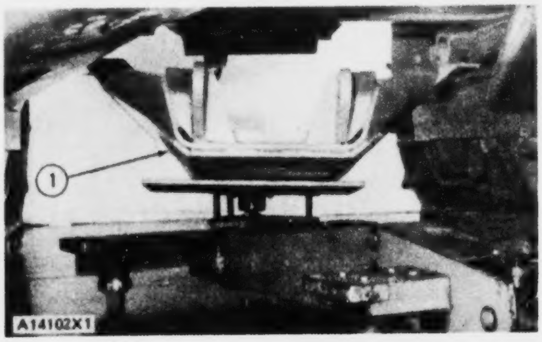


3. Put a floor jack in position under the crankcase guard (rear). Remove the three nuts (3) from each side of the crankcase guard (rear) (4). Lower the crankcase guard and remove it from under the machine. Weight of the crankcase guard (rear) is 700 lb. (318 kg).

INSTALL CRANKCASE GUARD (REAR) 12–7151



1. Put crankcase guard (1) on a floor jack. Lift the crankcase guard (1) until it makes contact with the frame of the machine. Install the six bolts and nuts that hold it in position. Remove the floor jack. Install the two bolts in the rear bracket of crankcase guard (1).



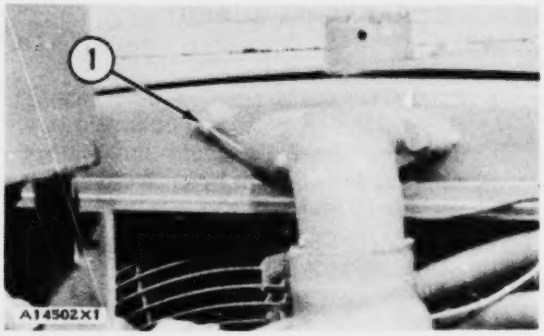
2. Put the guard that covers the equalizer bar on a floor jack. Lift the guard until it makes contact with the front and rear crankcase guards. Install the six bolts that hold it.

BRAKE PEDALS AND DASH

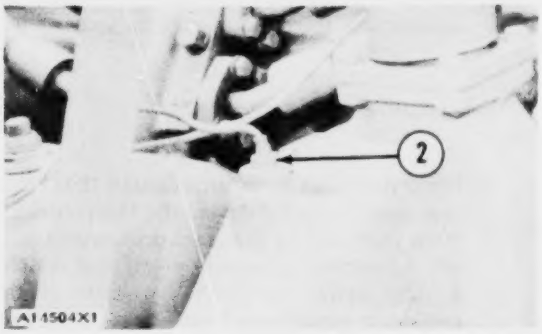
REMOVE BRAKE PEDALS AND DASH 11–7451

1. Remove the hood from the machine.

2. Disconnect water pressure gauge line (1) from the radiator.



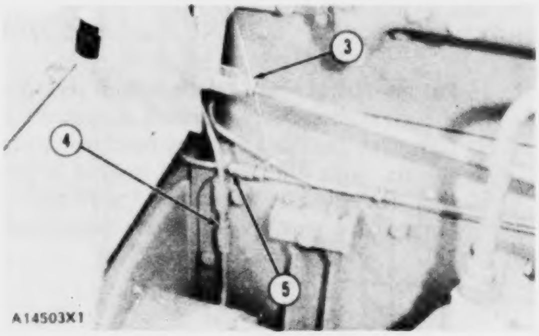
3. Disconnect the water temperature sending unit (2) from the water manifold.



4. Disconnect fuel pressure gauge lines (4) and (5).

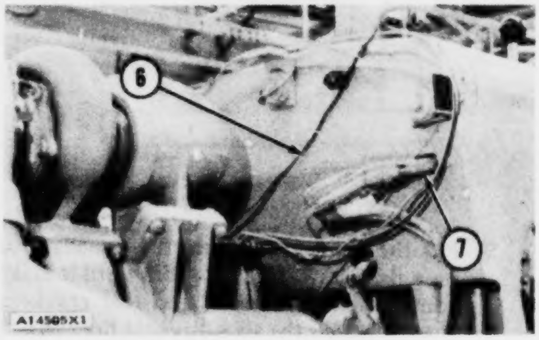
5. Disconnect governor control rod (3) from the bellcrank.

6. Remove the front floor plate.



7. Disconnect air indicator gauge line (6) at the air filter elbow.

8. Disconnect wiring harness (7) at the dash.

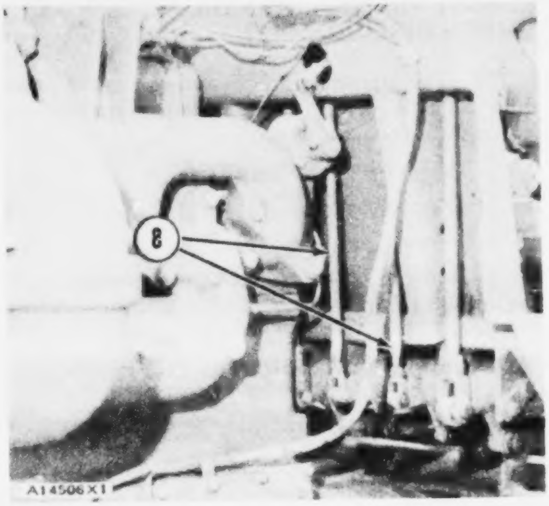


BRAKE PEDALS AND DASH

9. Remove the cover from the top of the dash.

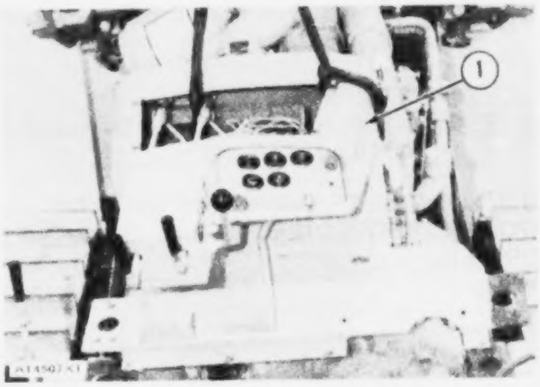
10. Disconnect four rods (8) for the steering clutch controls and the brake pedals.

11. Fasten a hoist to the dash. Remove the six bolts that hold the dash to the supports on the frame of the machine. Remove the dash. Weight of the dash is 300 lb. (136.07 kg).



INSTALL BRAKE PEDALS AND DASH 12–7451

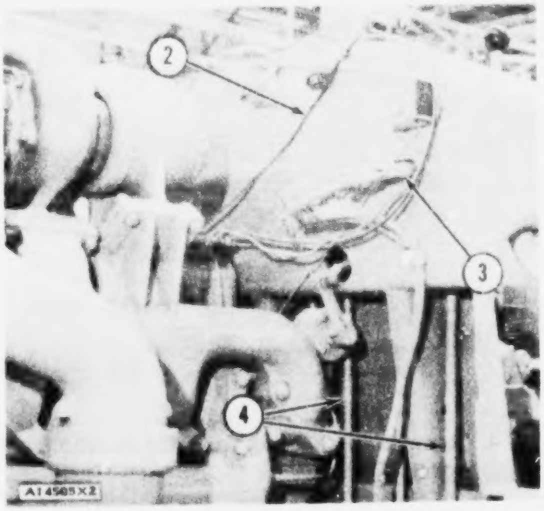
1. Fasten a hoist to the dash. Put dash (1) in position on the supports of the frame. Install the six bolts that hold the dash in position. Install the cover on top of the dash.



2. Connect four rods (4) for the steering clutch controls and the brake pedals.

3. Connect wiring harness (3) to the dash.

4. Connect air indicator gauge line (2) to the elbow of the air filter.



5. Connect the governor control rod to the bellcrank.

6. Connect the fuel gauge lines for the fuel pressure gauge.

7. Install the water temperature sending unit in the water manifold.

8. Connect the water pressure gauge line to the radiator.

9. Install the hood.

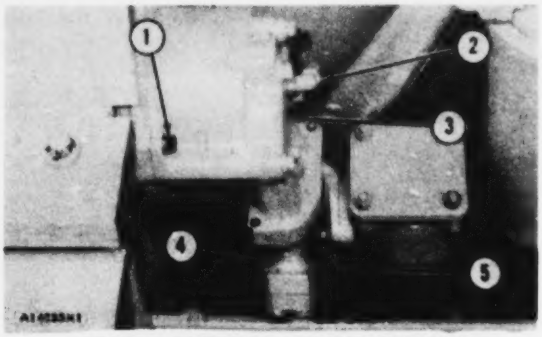
10. Install the front floor plate.

TRANSMISSION OIL PUMP (POWER SHIFT AND DIRECT DRIVE)

REMOVE TRANSMISSION OIL PUMP (POWER SHIFT & DIRECT DRIVE) 11–3153

NOTE: The transmission oil pumps for the power shift and the direct drive machines are removed and installed the same way.

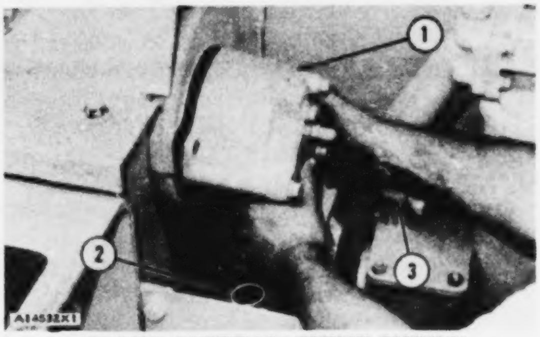
1. Disconnect vent line (2).
2. Disconnect oil supply line (4).
3. Remove two bolts (5).
4. Remove bolts (1). Remove transmission oil pump (3).



POWER SHIFT MACHINE SHOWN

INSTALL TRANSMISSION OIL PUMP (POWER SHIFT & DIRECT DRIVE) 12–3153

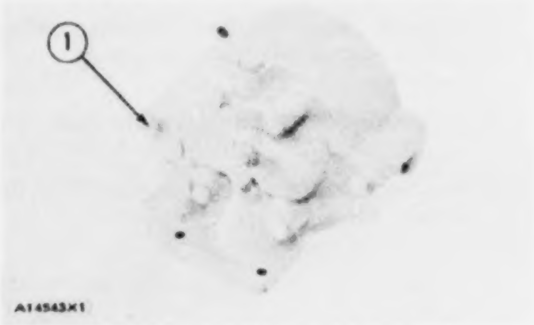
1. Put transmission oil pump (1) and a new O-ring seal in position on the power take-off housing. Install the bolts that hold it.
2. Connect oil supply line (2) to the transmission oil pump. Install the two bolts that hold the transmission oil pump to the transmission magnetic screen.
3. Connect the vent line (3) to the transmission oil pump.



POWER SHIFT MACHINE SHOWN

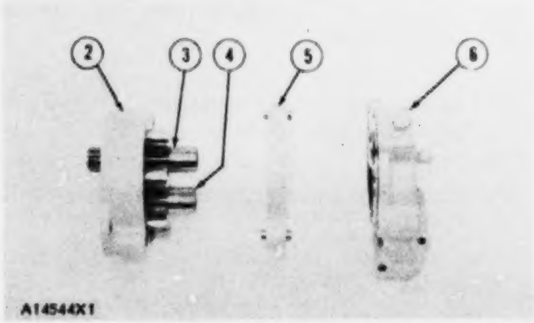
DISASSEMBLE TRANSMISSION OIL PUMP (POWER SHIFT & DIRECT DRIVE) 15–3153

start by:
a) remove transmission oil pump



POWER SHIFT MACHINE SHOWN

1. Remove bolts (1).
2. Remove cover (2) and body (5) from manifold (6).
3. Remove gears (3) and (4) from the cover.
4. Remove the bearing from the manifold and cover.



POWER SHIFT MACHINE SHOWN

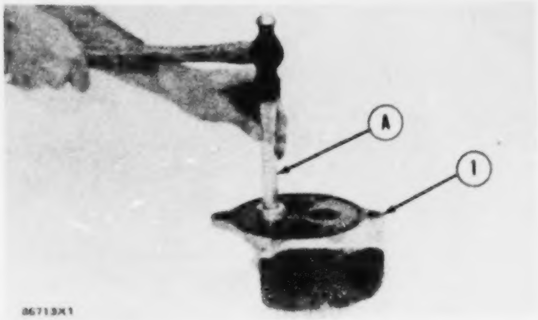
TRANSMISSION OIL PUMP
(POWER SHIFT AND DIRECT DRIVE)

ASSEMBLE TRANSMISSION OIL PUMP (POWER SHIFT & DIRECT DRIVE)

16–3153

Tools Needed		A	B
1P529	Handle	1	1
1P467	Drive Plate	1	1
1P469	Drive Plate	1	
1P480	Drive Plate		1

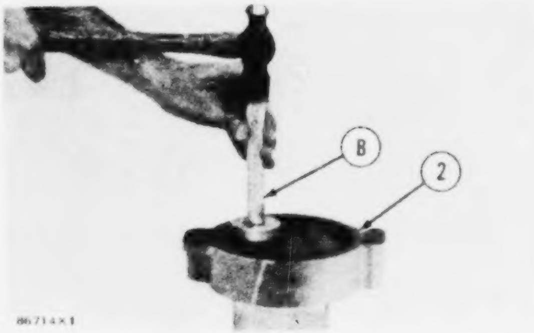
1. Put clean SAE 30 oil on all of the inner parts of the transmission oil pump.



86713X1

2. Install the bearings in the cover and manifold with tooling (A). Install the bearings to a depth of .062 in. (1.57 mm) below the machined surface of the cover and manifold. Make sure the joints in the bearings are at an angle of 30 ± 15° to a vertical line through the center of the gears.

3. Install seal (5) in cover (2) with tooling (B).



86714X1

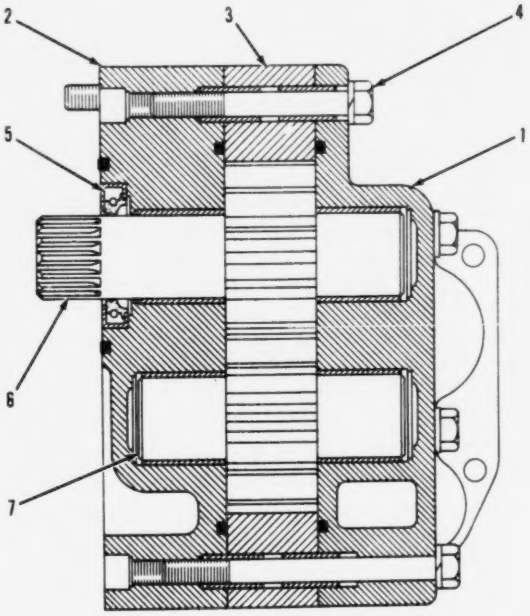
4. Install gears (6) and (7) in the cover. Inspect the O-ring seals and replace if necessary.

5. Put the dowels in body (3) in alignment with their holes in the cover. Put the body on the cover.

NOTE: If the dowels were removed from the body, install the dowels so that the outer faces are extended .19 ± .02 in. (4.8 ± 0.5 mm) from the outer faces of the body.

6. Put the holes in manifold (1) in alignment with the dowels in the body. Put the manifold on the body. Make sure the gears engage in their bearings in the manifold.

7. Install the bolts (4) that hold the pump together.



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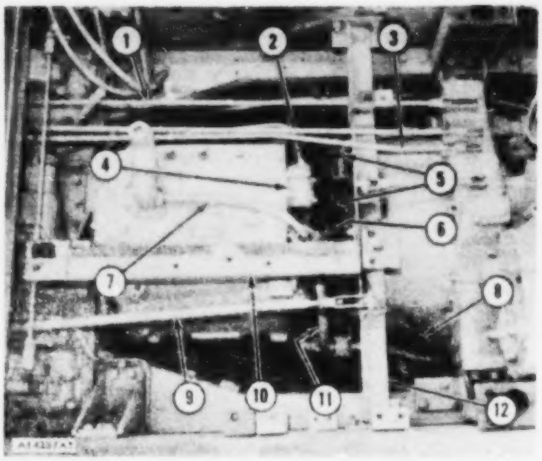
NOTE: The pump must turn freely by hand after assembly.

end by:
a) install transmission oil pump

TORQUE DIVIDER (POWER SHIFT)

REMOVE TORQUE DIVIDER (POWER SHIFT) 11–3100



start by:
- a) remove seat and seat frame
- b) remove crankcase guard (rear)
- c) remove universal joint (power shift)
- d) remove torque divider scavenge and circulating oil pump
- e) remove torque converter outlet relief valve
- f) remove brake pedals and dash

1. Drain the oil from the transmission and torque divider.

2. Remove rods (1), (2), (3) and (9) for the steering clutches and brakes. Put identification on the rods to prevent mixing at assembly.

3. Remove seat frame support (10) and cross-member (12).

4. Remove oil supply line (11) for the transmission hydraulic controls.

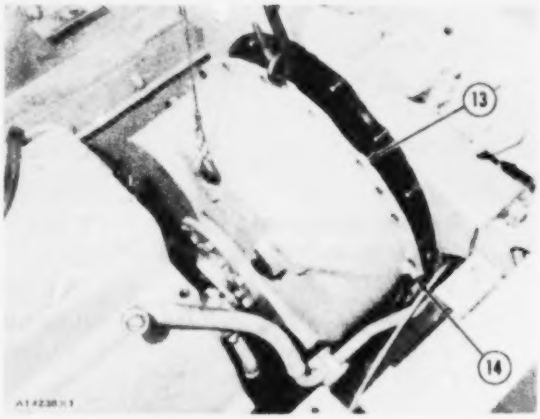
5. Remove oil supply line (6) for the torque converter.

6. Remove vent line (7) for the torque divider.

7. Remove vent line (8).

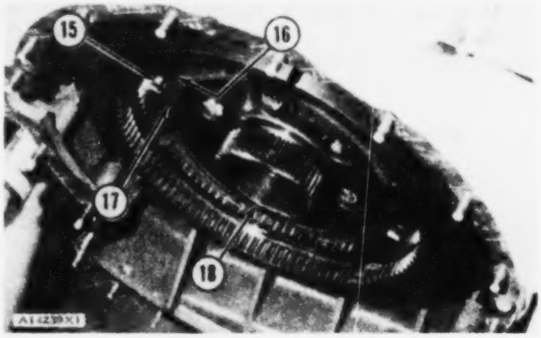
8. Remove transmission priority valve (4).

9. Remove oil outlet and inlet lines (5).



10. Install two 5/8"–11 NC forged eyebolts in the torque divider as shown. Fasten a hoist to the torque divider. Remove the nuts and washers that hold the torque divider to the flywheel housing. Make a separation of the torque divider from the flywheel housing until a wire (14) can be installed around the planet carrier.

CAUTION: The wire is to prevent the planet carrier from falling from the output shaft when the torque divider is being removed.

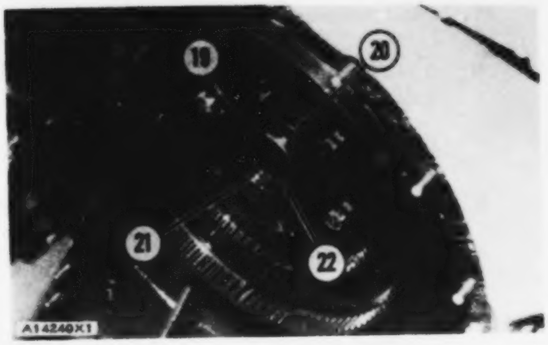


11. Remove torque divider (13). Weight of the torque divider is 850 lb. (386 kg).

12. Remove bolts (15), locks (16) and retainers (17). Remove gear (18).

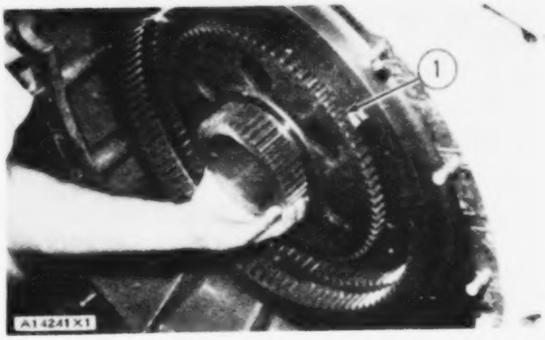
TORQUE DIVIDER (POWER SHIFT)

13. Remove snap ring (19). Remove washer (20).



14. Remove snap ring (21) and pilot bearing (22).

INSTALL TORQUE DIVIDER (POWER SHIFT) 12–3100

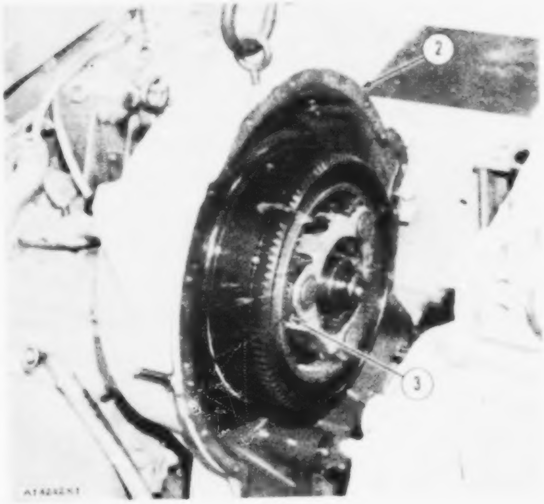


1. Install the pilot bearing in the flywheel. Install the snap ring that holds it.

2. Install the washer over the pilot bearing. Install the snap ring that holds it.

3. Put gear (1) into position in the flywheel. Install the retainers, locks and bolts that hold it.

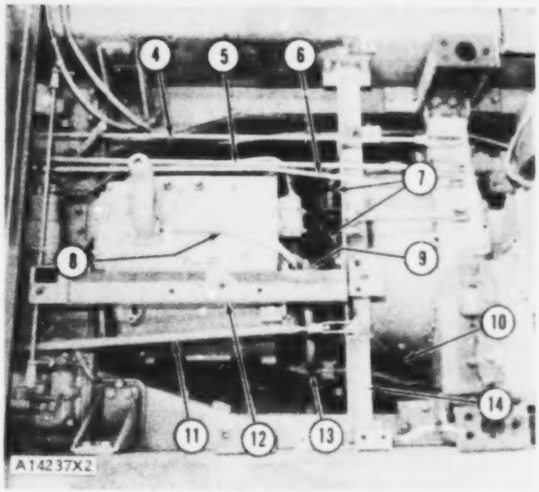
CAUTION: Make sure wire (3) is around the planet carrier. The wire will prevent the planet carrier from falling off of the output shaft when the torque divider is installed.



4. Fasten a hoist to the torque divider (2) and put it into position on the flywheel housing. Remove wire (3). Make sure the teeth of the gears for the planet carrier are in alignment with the teeth on the gear that is fastened to the flywheel. Turn the output shaft slowly while the torque divider is pushed in position against the flywheel housing.

CAUTION: Do not use force to engage the torque divider in the flywheel housing.

TORQUE DIVIDER (POWER SHIFT)



5. Install outlet and inlet lines (7).
6. Install the priority valve on the transmission.
7. Install vent line (10).
8. Install vent line (8) for the torque divider.
9. Install oil supply line (9) for the torque converter.
10. Install oil supply line (13) for the transmission hydraulic controls.
11. Install crossmember (14) and seat frame support (12).
12. Install rods (4), (5), (6) and (11) for the steering clutches and brakes.
13. Fill the transmission and torque divider with oil to the correct level. See, LUBRICATION AND MAINTENANCE GUIDE.

end by:
- a) install brake pedals and dash
- b) install torque converter outlet relief valve
- c) install torque divider scavenge and circulating oil pump
- d) install universal joint (power shift)
- e) install crankcase guard (rear)
- f) install seat and seat frame

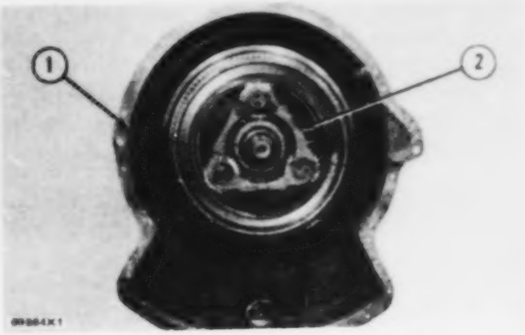
TORQUE DIVIDER (POWER SHIFT)

DISASSEMBLE TORQUE DIVIDER (POWER SHIFT) 15–3100

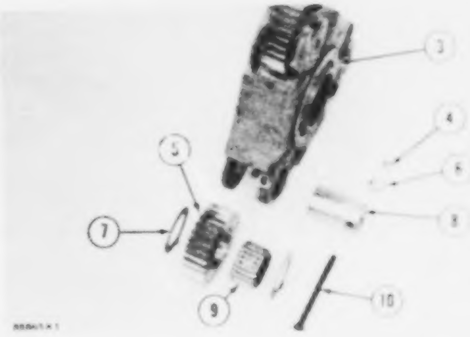
Tools Needed		A	B	C
1P2420	Repair Stand	1		
8B7560	Step Plate		1	
8B7548	Puller Assembly		1	1
8B7551	Bearing Puller Attachment		1	
8H684	Ratchet Box Wrench		1	1
8B7554	Bearing Cup Puller Attachment			1
8B7549	Leg			2
8B7559	Adapter			2
5H9976	Screw			1

start by:
a) remove torque divider

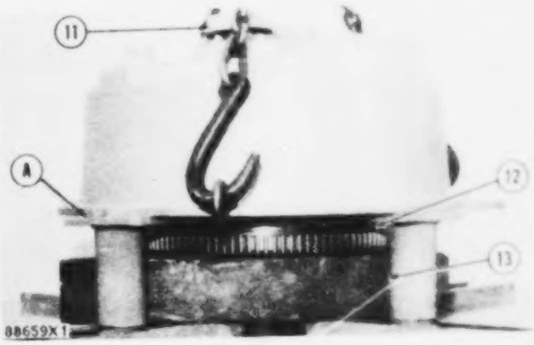
CAUTION: When a torque converter or divider has a failure, the complete oil system for the torque converter must be thoroughly cleaned. Any foreign material which is not removed from the oil system for the torque converter will be pushed through the hydraulic system for the transmission.



1. Remove wire (1). Remove planet carrier (2).

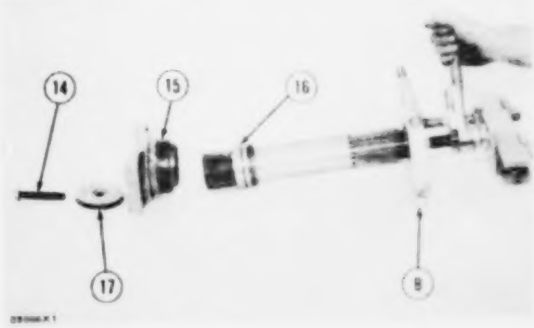


2. Remove nuts (4), locks (6), and bolts (10). Remove shafts (8). Remove washers (7) and gears (5). Remove the bearings (9) from the gears. Check thrust washers (3) on each side of the planet carrier for damage or wear. Remove the thrust washers if necessary.



3. Install the torque divider on tool (A). Put blocks (13) under the torque converter housing (12) to keep it in position in the torque divider.

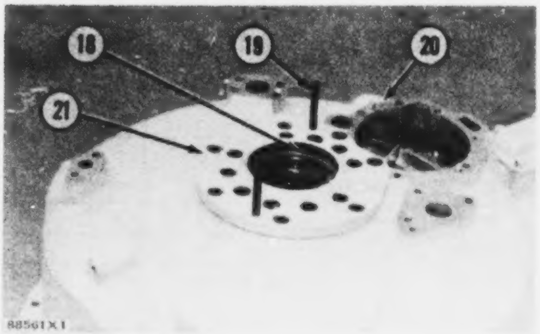
4. Remove output shaft (11).



5. Remove bolt (14), retainer (17), and output flange (15) from the output shaft. Remove the bearing races (16) from each end of the output shaft with tooling (B).

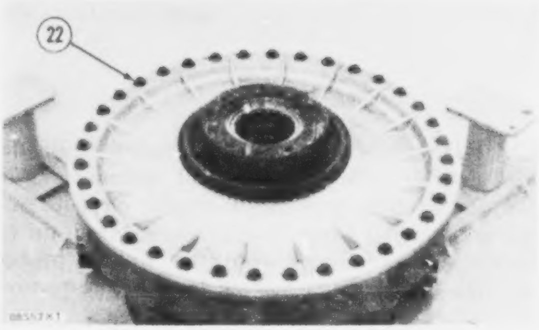
TORQUE DIVIDER (POWER SHIFT)

6. Remove the bolts that hold plate (21) to the cover for the torque divider. Install two 3/8"–16NC forcing screws (19) in the plate. Tighten the forcing screws evenly and remove the plate. Remove the lip type seal (18) from the plate.

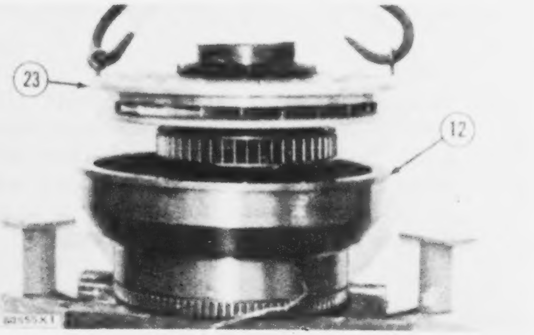


7. Install one 1/2"–13NC forged eyebolt and two 3/8"–16NC forged eyebolts in the cover for the torque divider. Fasten a hoist to the eyebolts. Remove the cover (20). Weight is 180 lb. (82 kg).

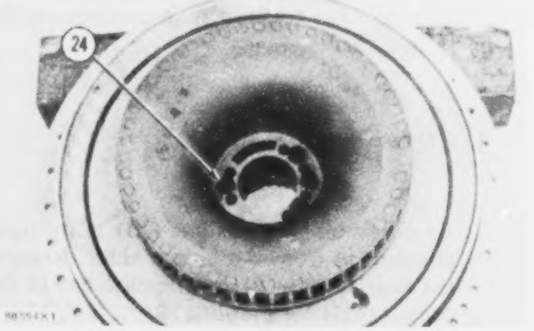
8. Remove the oil from the torque converter.



9. Remove thirty-six bolts (22).



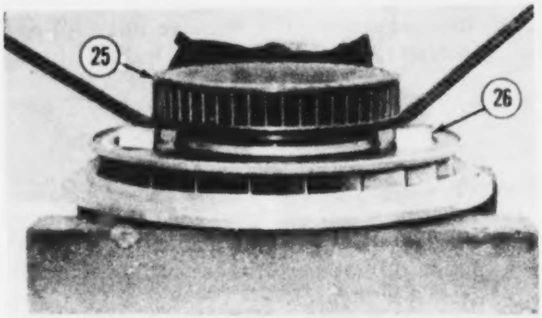
10. Install four 3/8"–16NC forcing screws in impeller (23). Tighten the forcing screws evenly until the impeller is free of the converter housing (12). Remove the forcing screws. Install two 3/8"–16NC forged eyebolts in the impeller. Fasten a hoist to the eyebolts and remove the impeller. Weight is 100 lb. (45 kg).



11. Remove bolts (24) that hold the stator wheel to the carrier.

TORQUE DIVIDER (POWER SHIFT)

12. Put two blocks (26) on the impeller. Put a force, evenly, against the bottom of the stator wheel (25) until it is free of the impeller. Remove the stator wheel.



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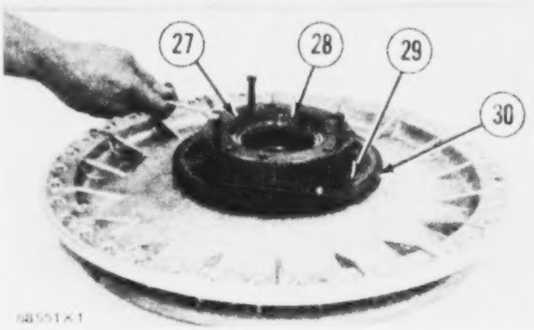
13. Install three 3/8"–16NC forcing screws in carrier (27). Tighten the forcing screws evenly and remove the carrier.

14. Remove snap ring (28).



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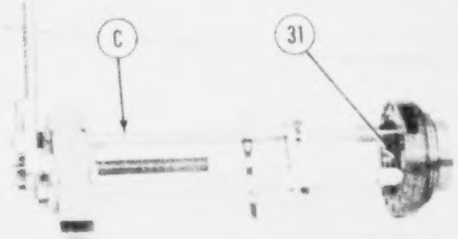
15. Remove outer race and roller assembly (31) from the carrier with tooling (C).



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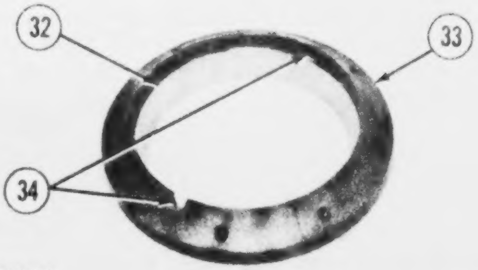
16. Remove bolts (29). Install two 3/8"–16NC forcing screws in the torque converter gear (30). Tighten the forcing screws evenly and remove the gear.

17. Remove carrier (33). Remove bearing cup (32) from the carrier with a hammer and soft punch through notches (34).



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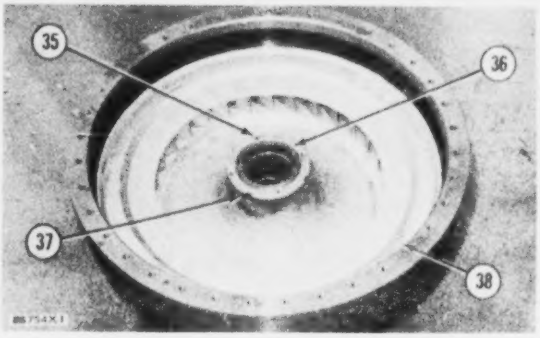
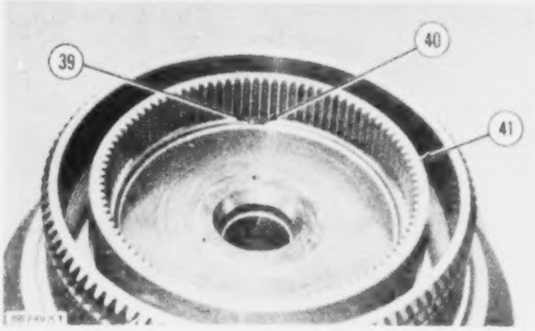
TORQUE DIVIDER (POWER SHIFT)

18. Remove screw (35). Remove nut (36) and washer (37).

19. Remove wheel (turbine) (38) if it is loose on the splines of the flange. If it is not loose, do not use force as it will be removed later. See Step 21.

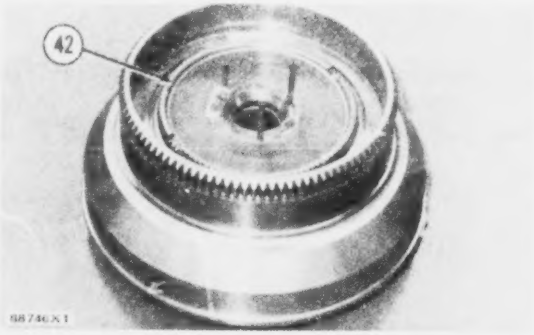


20. Remove spring pins (40). Pull the two ends of ring (39) together. Remove ring gear (41).



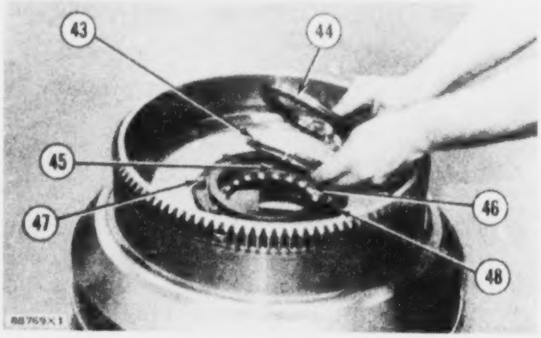
21. Put a block of wood under the turbine (if it has not been removed). Install three 3/8"–16NC forcing screws in flange (42). Tighten the forcing screws evenly and remove the flange. The turbine (if it has not been removed) will fall on the block. Remove the two bearings from the flange.

22. Remove bearing race (43) and carrier (44).

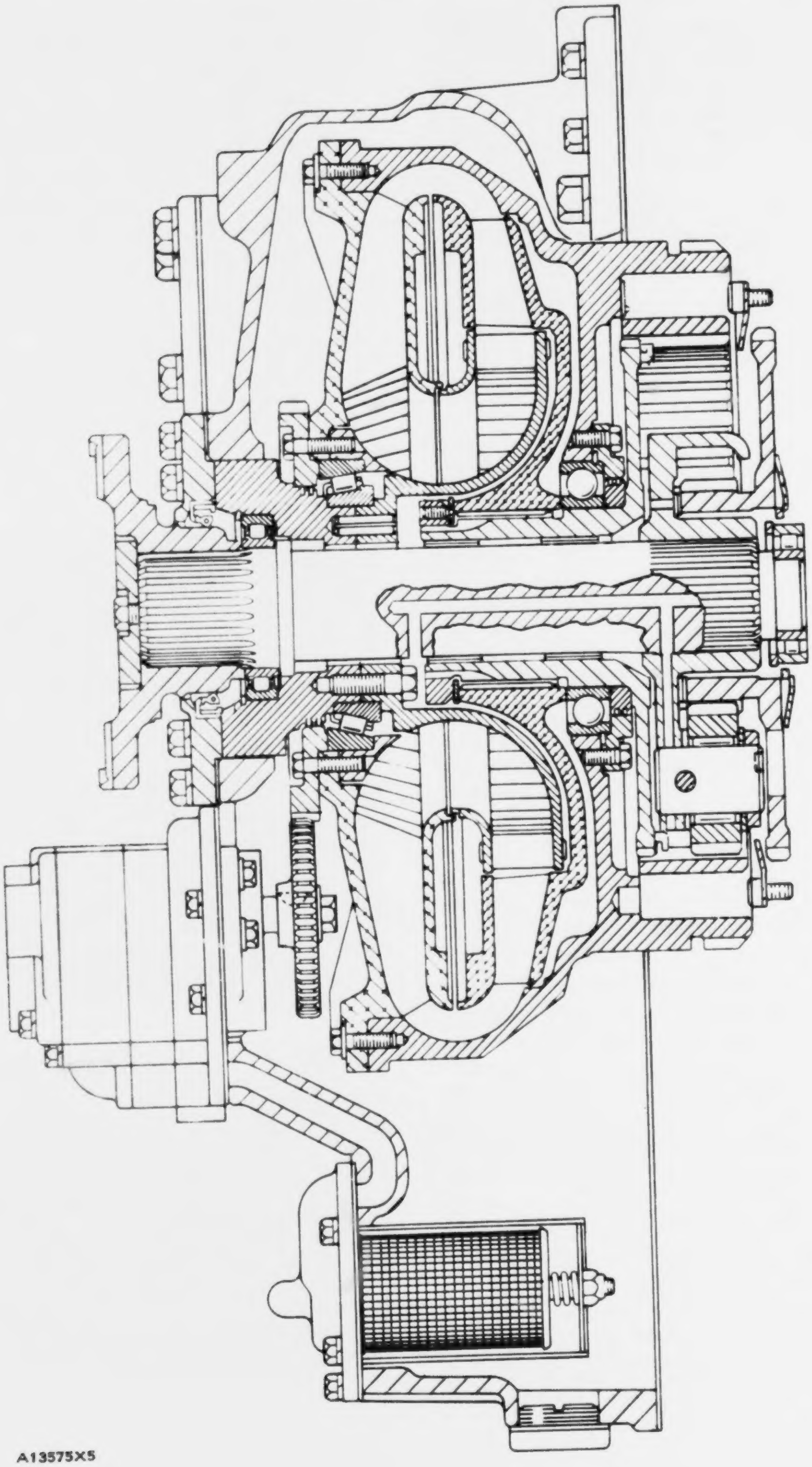


23. Remove bolts (47). Install two 3/8"–16NC forcing screws in retainer (48). Tighten the forcing screws evenly and remove the retainer.

24. Remove snap ring (45). Remove bearing (46).



TORQUE DIVIDER (POWER SHIFT)



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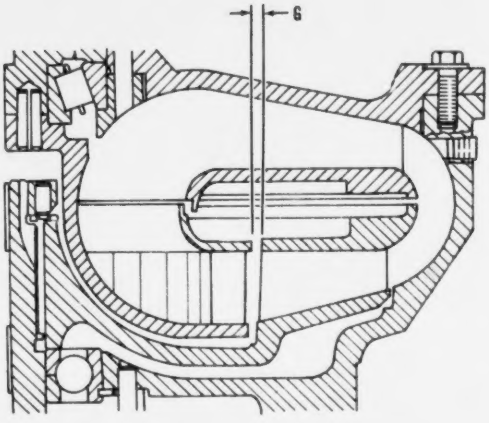
TORQUE DIVIDER (POWER SHIFT)

ASSEMBLE TORQUE DIVIDER (POWER SHIFT) 16–3100

Tools Needed		A	B	C	D	E
8S2328	Indicator Group	1				
FT532	Dial Test Spanner Wrench		1			
1P532	Handle			1		1
1P527	Drive Plate			1		
1P529	Handle				1	
1P494	Drive Plate				1	
1P491	Drive Plate				1	
1P525	Drive Plate					1
1P513	Drive Plate					1

1. There must be a minimum running clearance (G) between the stator wheel and turbine if the torque converter is to operate with efficiency.
2. Check the clearance between the outside diameter (K) of the stator wheel (stator) and the inside diameter (L) of the turbine as follows:
   a) Put four steel balls (3) in the turbine (2) as shown. The balls must be .062 in. (1.57 mm) in diameter. Put the balls approximately 90° apart.
   b) Put the stator (1) in position on the balls as shown. Make sure the balls do not move. Turn the stator until the smooth surface of the turbine is against the balls.
   c) Install tool group (A) on the turbine. Move the stator toward the stem of the dial indicator until its outside diameter is against the inside diameter of the turbine. Move the stem against the stator as shown. Set the dial indicator on ZERO.
   d) Move the stator 180° away from the stem until its outside diameter is against the inside diameter of the turbine. Make this measurement at four points 90° apart around the turbine. The dimension read on the dial indicator is the total clearance across the diameters. This dimension must be .012 to .018 in. (0.30 to 0.46 mm).
   e) The running clearance or clearance (F) is one half of the clearance across the diameters. Clearance (G) must be .006 to .009 in. (0.15 to 0.23 mm).
3. Make a replacement of the stator or turbine if the dimensions measured are not acceptable.



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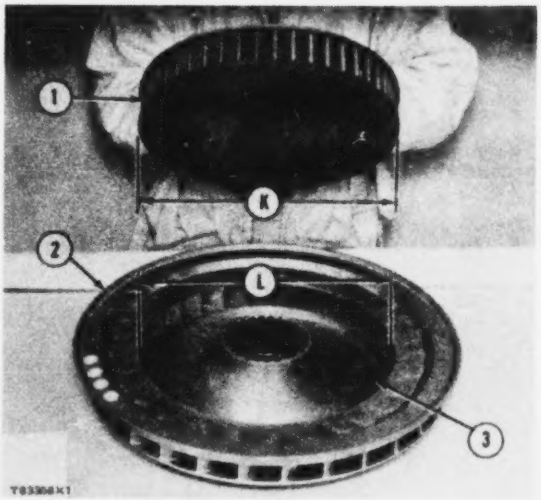

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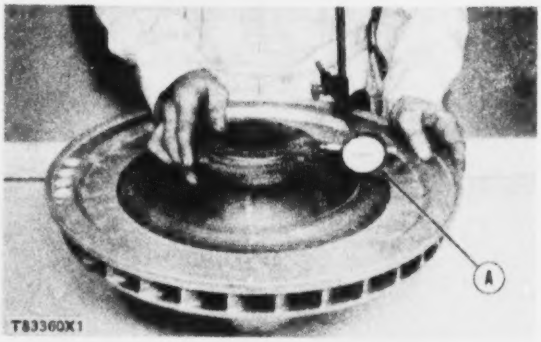

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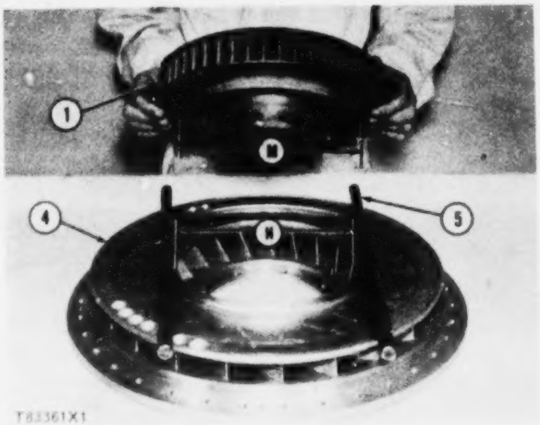
TORQUE DIVIDER (POWER SHIFT)

4. There must be a minimum running clearance (H) between the stator and impeller if the torque converter is to operate with efficiency.
5. Check the clearance between the outside diameter (M) of the inner flange for the stator and the inside diameter (N) of the impeller flange as follows:
    a) Put two rods (5) on impeller (4) as shown. Make sure the rods are .62 in. (15.7 mm) in diameter and approximately 20 in. (508 mm) long.
    b) Put the stator (1) in position on the rods.
    c) Install tool group (A) on the edge of the impeller. Move the stator toward the stem of the dial indicator until the outside diameter of its flange is against the inside diameter of the impeller. Move the stem of the dial indicator against the stator. Set the dial indicator on ZERO.
    d) Move the stator 180° away from the stem until the outside diameter of its flange is against the inside diameter of the impeller. The dimension read on the dial indicator is the total clearance across the diameters. Make a measurement at four points 90° apart around the impeller. The total clearance across the diameters must be .009 to .015 in. (.023 to .038 mm).
    e) The running clearance or clearance (G) is one half of the clearance across the diameters. Clearance (G) must be .0045 to .0075 in. (0.114 to 0.191 mm).
6. Make a replacement of the stator or impeller if the dimensions measured are not acceptable.



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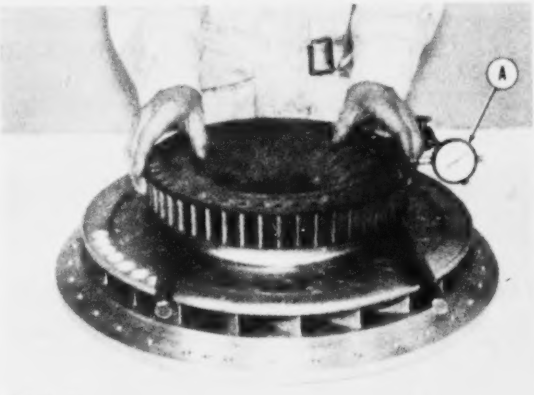

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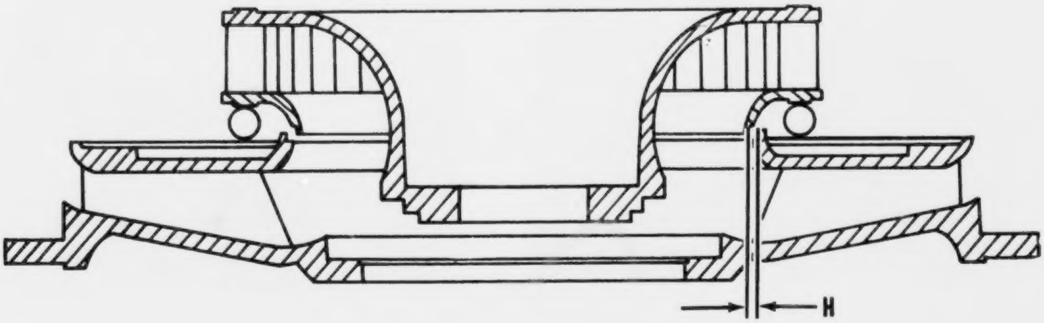

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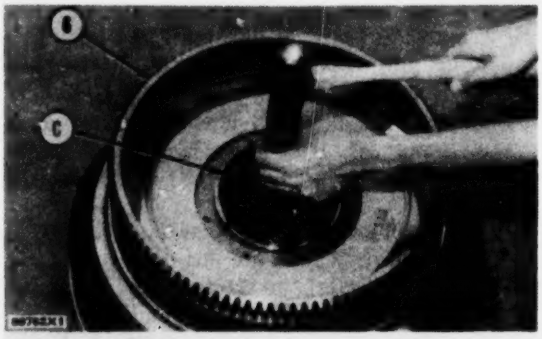
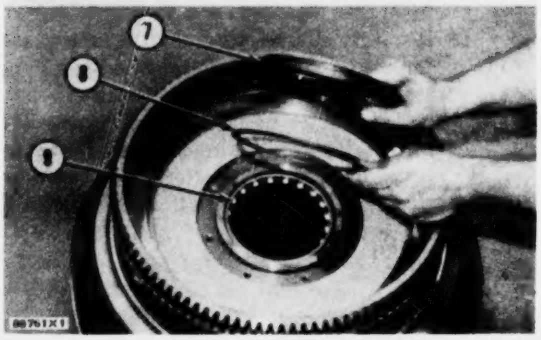
TORQUE DIVIDER (POWER SHIFT)

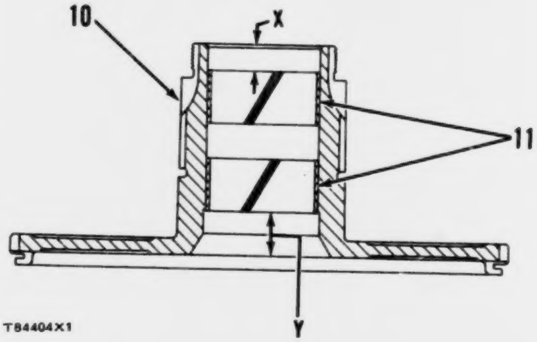
7. Install bearing (9) in converter housing (6) with tooling (C).



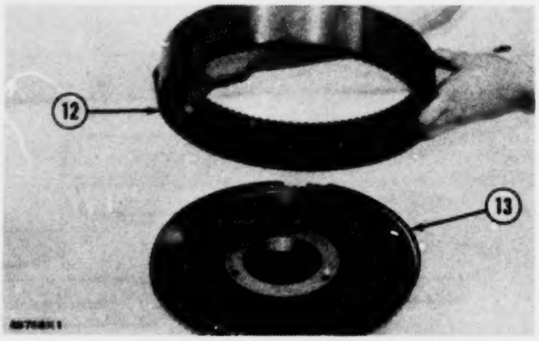
8. Install snap ring (8) over the bearing. Install retainer (7) and the bolts that hold it. Tighten the bolts to a torque of 36 ± 2 lb.ft. (5.0 ± 0.3 mkg).



9. Install bearings (11) in flange (10). Make sure dimension (X) is .680 in. (17.27 mm). Make sure dimension (Y) is 1.14 in. (29.0 mm).

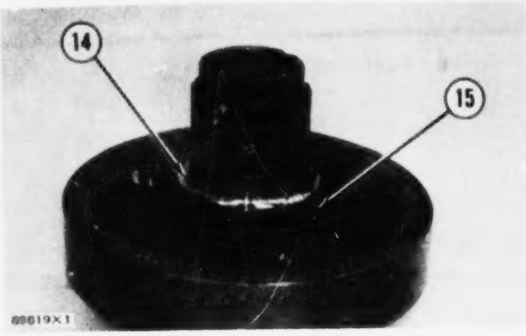


10. Install ring (13) in the groove in the flange. Pull the two ends of the ring together. Put the splines of ring gear (12) in alignment with the splines on the flange. Install the ring gear on the flange. Make sure the ring engages in the groove in the ring gear. Install the two spring pins that keep the ring in the grooves.



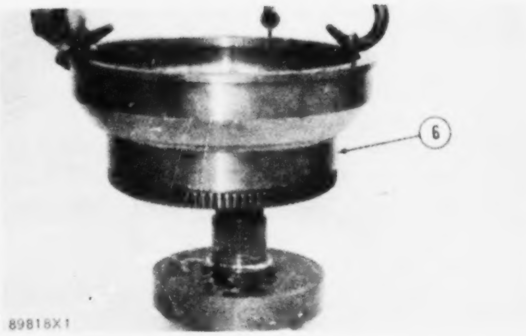
TORQUE DIVIDER (POWER SHIFT)

11. Turn the flange and ring gear over. Install carrier (15) and bearing race (14). Make sure the ends of the rings in the carrier are engaged.



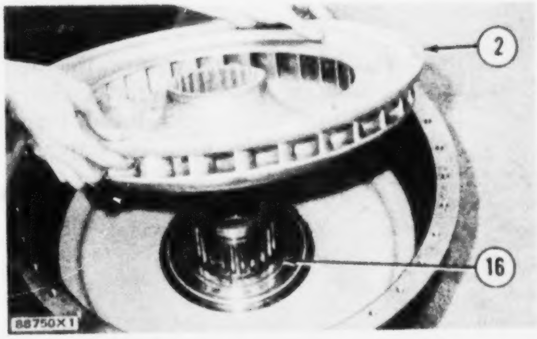
12. Install three 3/8"–16NC forged eyebolts in converter housing (6). Fasten a hoist to the eyebolts. Put the housing in position over the flange.

CAUTION: Make sure the rings in the carrier are in alignment with the bearing in the housing.



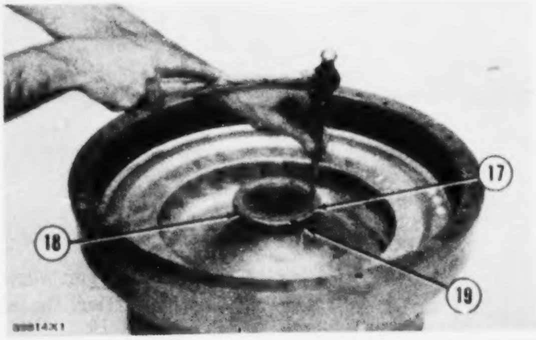
13. Install bearing race (16) over the flange.

14. Put the splines of the turbine (2) in alignment with the splines of the flange. Install the turbine.



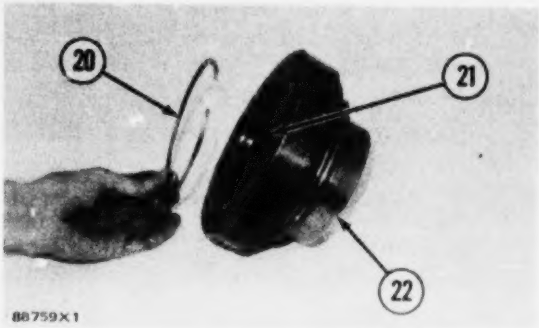
NOTE: Clearance between the outside diameter of the inner flange of the turbine (2) and the inside diameter of the converter housing (6) must be .055 to .075 in. (1.0 to 1.91 mm). The running clearance is one half of the clearance across the diameter. The running clearance must be .0275 to .0375 in. (0.699 to 0.953 mm). See the specifications.

15. Install washer (19) and nut (18) on the flange. Tighten the nut to a minimum torque of 150 lb.ft. (20.7 mkg) with tool (B). Tighten the nut if necessary to put the hole in the nut in alignment with the hole in the washer. Install screw (17). Put two marks (stake) 180° apart in the nut to hold the screw in position.

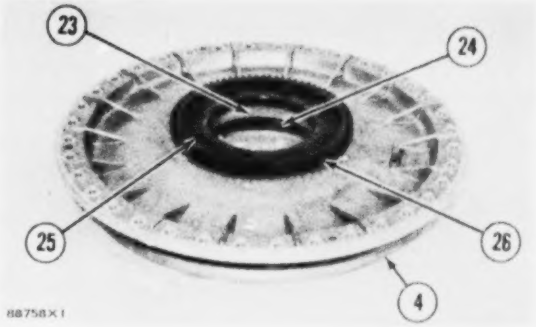


TORQUE DIVIDER (POWER SHIFT)

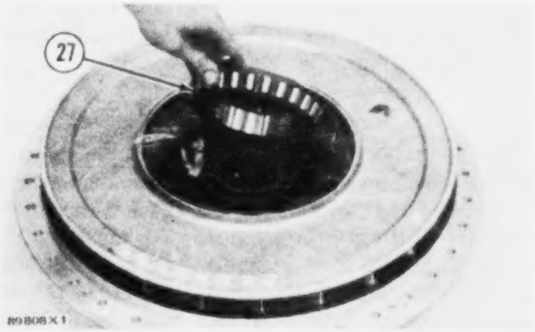
16. Lower the temperature of the outer race and roller assembly (21) and install it in carrier (22). Install snap ring (20) that holds it.



17. Lower the temperature of the bearing race (23). Install the race in carrier (24).

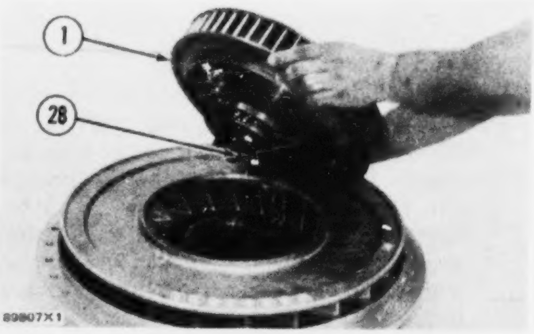


18. Put carrier (24) and torque converter gear (26) in position on the impeller (4). Install bolts (25). Tighten the bolts to a torque of 36 ± 2 lb.ft. (5.0 ± 0.3 mkg).



19. Put a small amount of grease on the metal rings in the carrier. Make sure the ends of the metal rings are engaged. Install the impeller over the carrier with the torque converter gear toward the carrier.

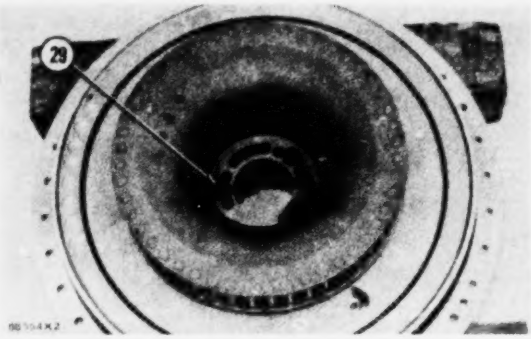
20. Install bearing cone (27) over the carrier into its bearing race.



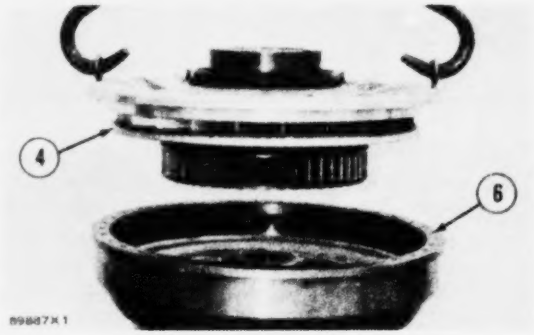
21. Put pins (28) for stator wheel (1) in alignment with their holes in the carrier. Install the stator wheel.

TORQUE DIVIDER (POWER SHIFT)

22. Install bolts (29) that hold the stator wheel to the carrier. Tighten the bolts to a torque of 81 ± 4 lb.ft. (11.2 ± 0.6 mkg).

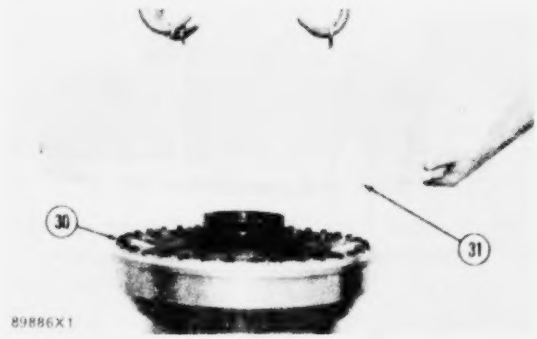


23. Install two 3/8"–16NC forged eyebolts in the impeller (4). Fasten a hoist to the eyebolts. Install the impeller on the converter housing (6).

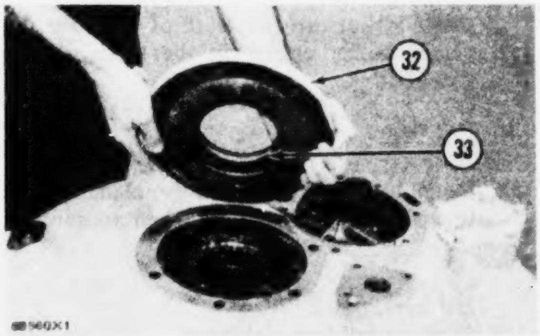


24. Install bolts (30) that hold the impeller to the converter housing. Tighten the bolts to a torque of 36 ± 2 lb.ft. (5.0 ± 0.3 mkg).

25. Install a 1/2"–13NC forged eyebolt and two 3/8"–16NC forged eyebolts in torque divider cover (31). Fasten a hoist to the eyebolts. Put the cover in position on the converter housing.

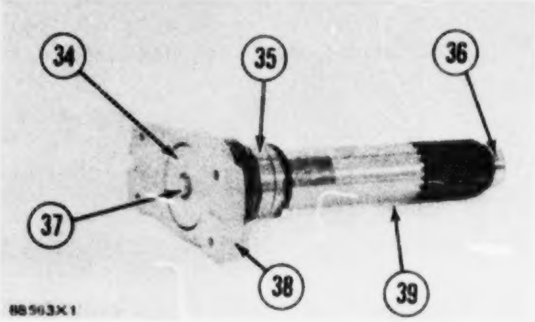


26. Install seal (33) in plate (32) with tooling (E). Put the plate in position on the cover. Install the 17 bolts that hold it.



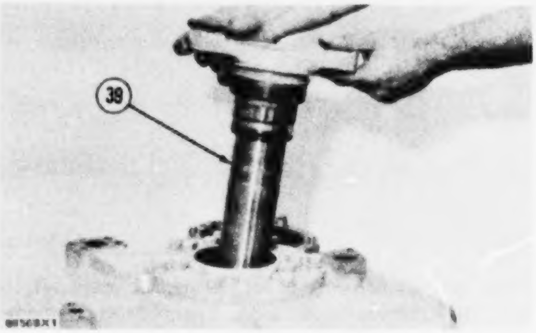
TORQUE DIVIDER (POWER SHIFT)

27. Heat bearing races (35) and (36) in oil to a maximum temperature of 275°F (135°C). Install the races on their respective ends of output shaft (39).



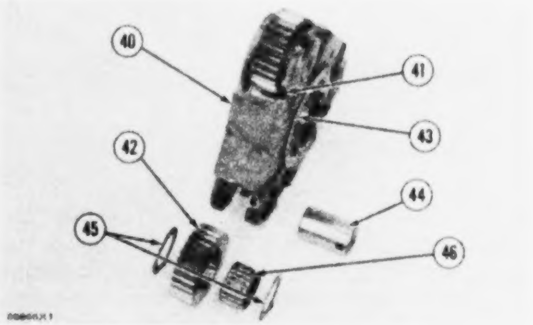
28. Put the splines of output flange (38) in alignment with the splines of the output shaft. Install retainer (34) and bolt (37). Tighten the bolt to a torque of 85 ± 5 lb.ft. (11.8 ± 0.7 mkg).

29. Install output shaft (39) in the torque divider.



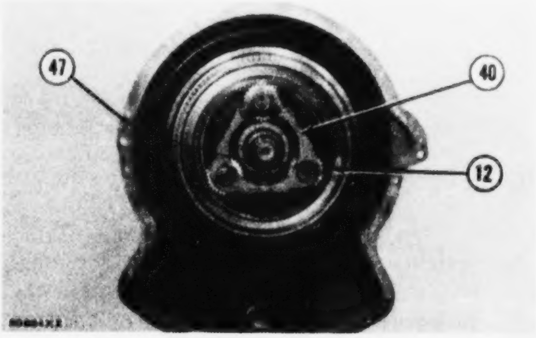
30. Install bearings (46) in gears (42). Install the gears and washers (45) in planet carrier (40). Install shafts (44) through the planet carrier, washers, and gears. Put the holes in the shafts in alignment with the holes in the planet carrier. Install the bolts (41), locks, and nuts.

NOTE: Install bolts (41) so their heads are all toward the same direction. This will give balance to the planet carrier.



31. If new thrust washers (43) are installed, fasten the thrust washers with new rivets.

32. Install planet carrier (40) over the output shaft. Make sure the teeth of gears for the planet carrier engage in the teeth of ring gear (12).



33. Install a wire (47) around the planet carrier to prevent it from falling when assembling.

end by:
   a) install torque divider

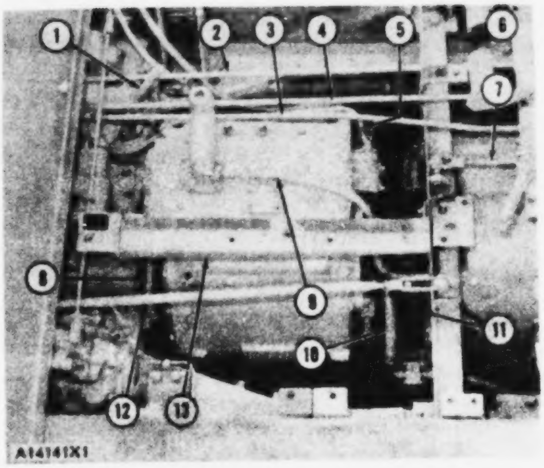
TRANSMISSION (POWER SHIFT)

REMOVE TRANSMISSION (POWER SHIFT) 11–3150

start by:
- a) remove crankcase guard (rear)
- b) remove seat and seat frame
- c) remove torque divider scavenge and circulating oil pump
- d) remove torque converter outlet relief valve
- e) remove universal joint (power shift)

1. Drain the oil from the transmission and the bevel gear case.

2. Remove rods (2), (3), (4) and (12) for the steering clutches and brakes. Put identification on the rods to prevent mixing at assembly.



3. Disconnect rod (7) from the lever on the crossmember.

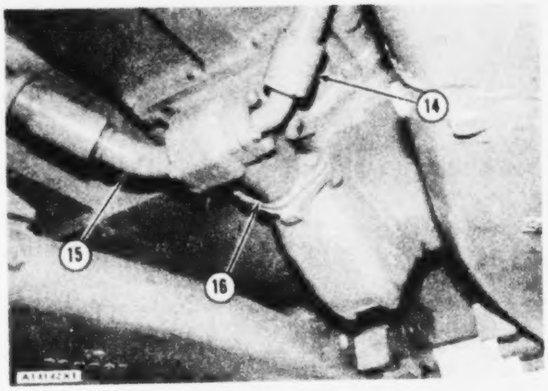
4. Remove seat frame support (13) and crossmember (6).

5. Remove oil level gauge (1) from the bevel gear case.

6. Remove vent line (9) for the torque divider.

7. Remove oil supply line (11) for the torque converter.

8. Remove oil supply line (10) for the transmission hydraulic controls.



9. Remove oil supply line (5) for the steering clutches and brake hydraulic controls.

10. Remove the steering brake cooling and lubrication oil supply line (8).

11. Disconnect oil lines (14) and (15) from the flange.

12. Remove the bolts that hold flange (16) in position. Remove the flange.

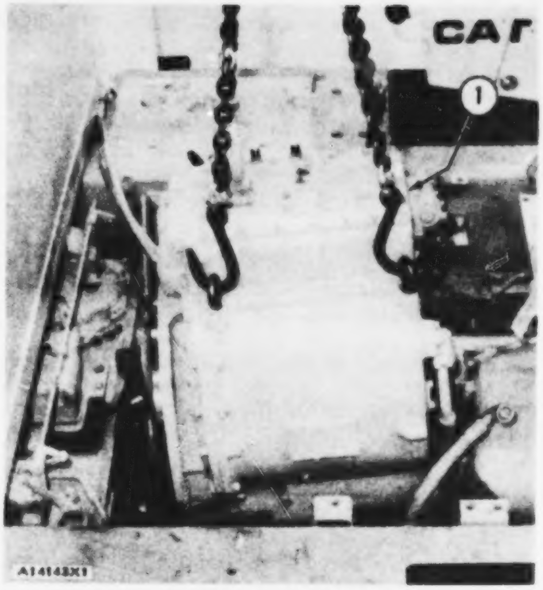
13. Install four 3/4"10 NC forged eyebolts in the transmission case. Fasten a hoist to the transmission. Remove the nuts and washers that hold the transmission to the bevel gear case. Remove the transmission. Weight of the transmission is 2000 lb. (907 kg).

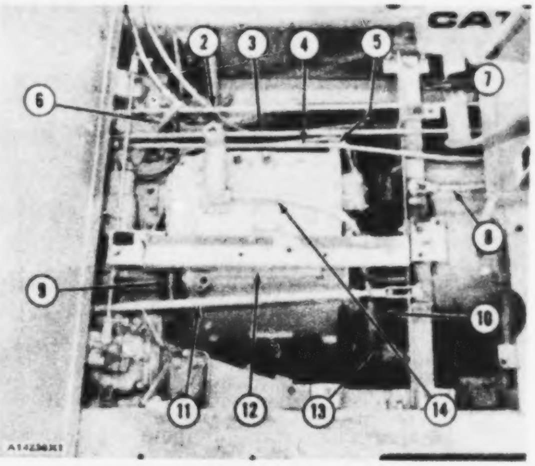
TRANSMISSION (POWER SHIFT)

INSTALL TRANSMISSION (POWER SHIFT) 12–3150

1. Fasten a hoist to the transmission. Put the transmission (1) in position in the bevel gear case. Install the washers and nuts that hold it.
2. Install the flange on the bottom of the transmission. Connect the two oil supply lines to the flange.
3. Install oil supply line (10) for the torque converter.
4. Install oil supply line (13) for the transmission hydraulic controls.
5. Install oil supply line (5) for the steering clutches and brake hydraulic controls.
6. Install steering brake cooling and lubrication oil supply line (9).
7. Install vent line (14).
8. Install rods (2), (3), (4) and (11) for the steering clutches and brakes.
9. Install crossmember (7) and seat frame support (12). Connect rod (8) to the lever on the crossmember.
10. Install oil level gauge (6).
11. Fill the transmission and bevel gear case with oil to the correct level. See LUBRICATION AND MAINTENANCE GUIDE.

end by:
- a) install universal joint (power shift)
- b) install torque converter outlet relief valve
- c) install torque divider scavenge and circulating oil pump
- d) install seat and seat frame
- e) install crankcase guard (rear)





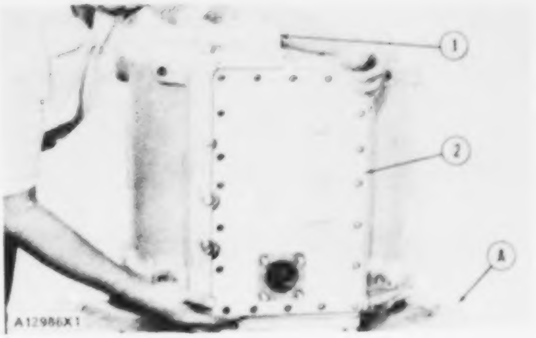
TRANSMISSION (POWER SHIFT)

DISASSEMBLE TRANSMISSION (POWER SHIFT) 15–3150

Tools Needed		A	B	C	D	E	F	G	H
1P2420	Repair Stand	1							
1P3075	Puller Group		1						
1P820	Puller Group				1				
8B7551	Bearing Pulling Attachment				1		1	1	
8B7560	Step Plate				1		1		1
8B7549	Leg				2				
5F7369	Leg				2				
8B7555	Adapter				2				
1B4207	Nut				2				
3H465	Plate				4				
9S5800	Pump Group				1				
FT833	Clamp			2					
1P74	Puller Assembly					1			
8B7548	Puller Assembly						1	1	1
1P515	Drive Plate							1	
8H684	Ratchet Box Wrench						1	1	1
5F7343	Bearing Pulling Attachment								1
5F7342	Adapter								2

start by:
a) remove transmission

1. Put transmission on tool (A).
2. Remove the bolts and washers that hold cover (2) in position. Remove the cover.
3. Remove priority valve (1).
4. Remove the three bolts that hold the pressure control valve in position. Remove pressure control valve (3).
5. Remove spring (4).
6. Loosen bolt (8). Remove shaft (7) from lever (9). Move the lever away from the selector valve.
7. Loosen bolt (6). Remove shaft (5) from the lever. Move the lever away from the selector valve.



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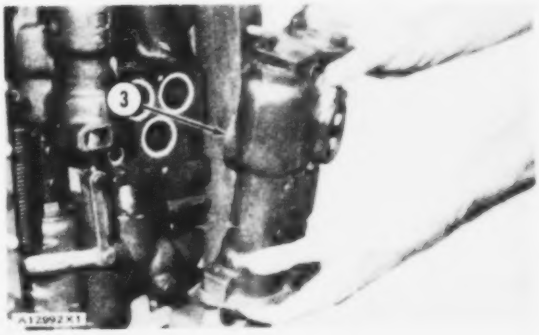

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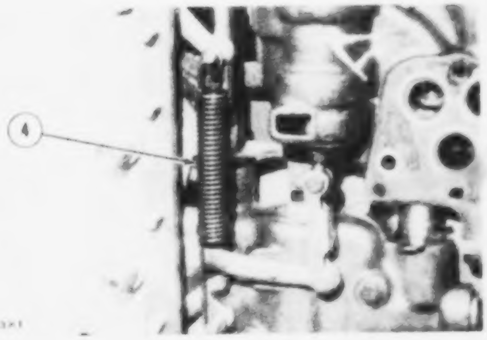

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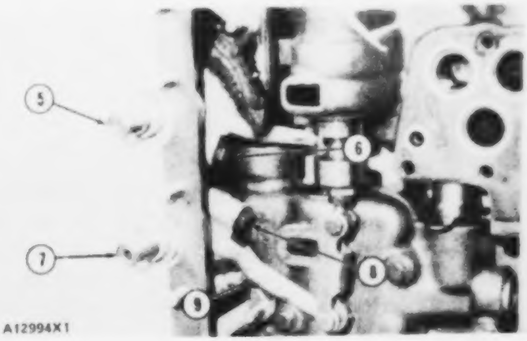

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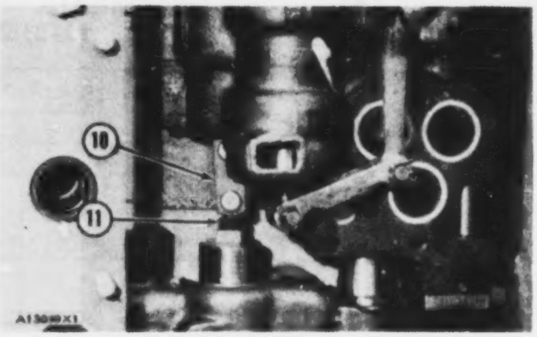
TRANSMISSION (POWER SHIFT)

8. Loosen nut (11). Remove the bolts that hold the directional valve in position. Remove link assembly (10) from the valve.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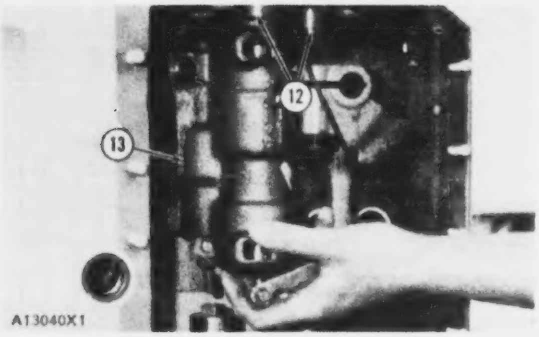
9. Remove two tubes (12). Remove directional valve (13).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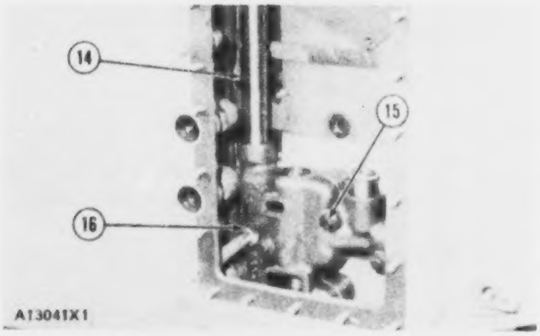
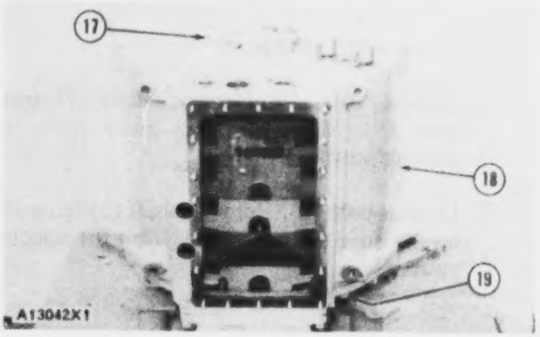
13
A13040X1

10. Remove tube (14). Remove bolts (15) that hold the selector valve in position. Remove selector valve (16).


14
15
16
A13041X1

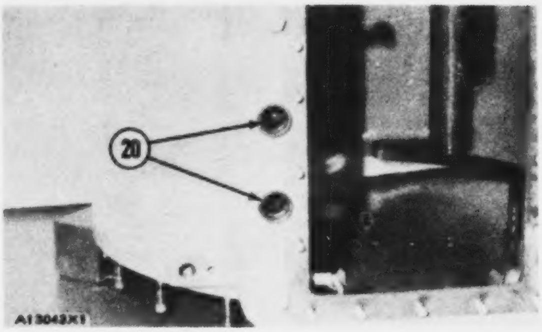
11. Remove bolts (17). Remove nuts (19) that hold the transmission case to the transfer gear case. Install two 3/4"–10 NC forged eyebolts in the case. Fasten a hoist to the case. Remove case (18). Weight of the case is 330 lb. (150 kg).


17
18
19
A13042X1

TRANSMISSION (POWER SHIFT)

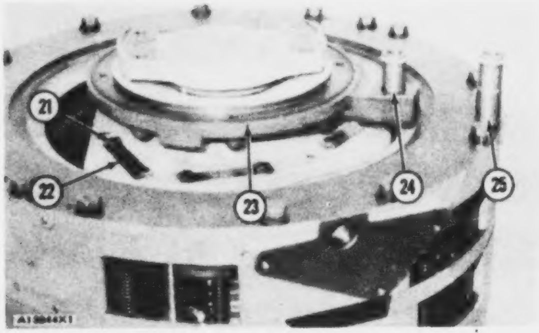
12. Remove the two bushings and seals (20) from the case.

13. Remove tubes (24) and (25).


20
A13043X1

14. Remove bolts (21) and locks (22).

15. Install two 3/8"–16 NC forged eyebolts in bearing cage (23) for the input shaft. Fasten a hoist to the input shaft. Remove the input shaft and bearing cage as a unit. Weight of the unit is 140 lb. (64 kg).


21
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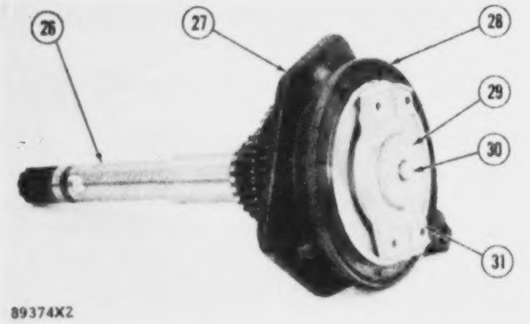
A13044X1

16. Remove bolt (30), retainer (29) and input flange (31).


26
27
28
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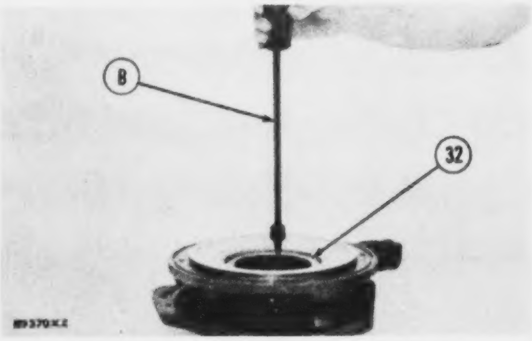
31
89374X2

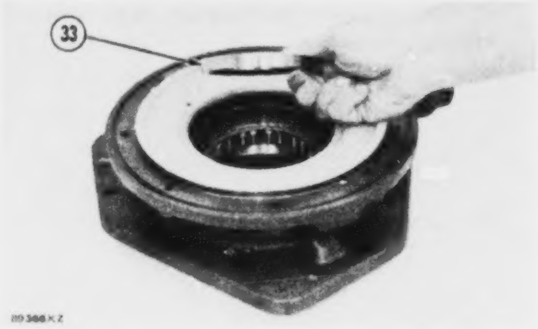
17. Remove bearing cages (28) and (27) as a unit from the input shaft (26).

18. Remove lip type seal (32) from the bearing cage with tool group (B).

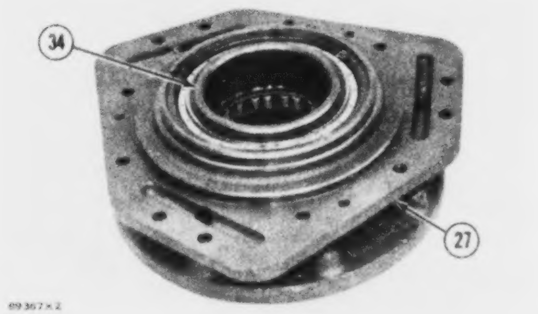

B
32
89370X2

TRANSMISSION (POWER SHIFT)

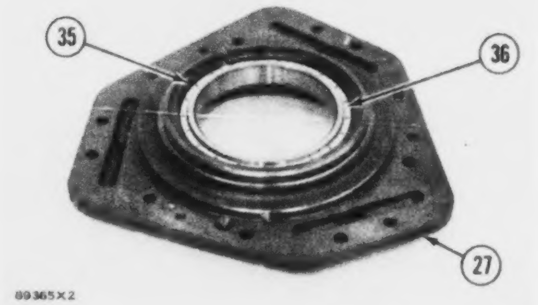
19. Remove spacer (33) from the bearing cage.



20. Turn the bearing cage over. Remove spiral ring (34). Remove bearing cage (27).

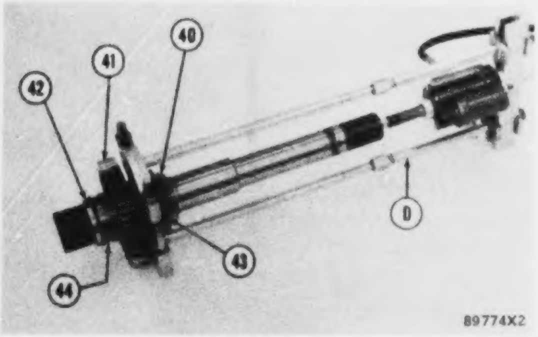

34
27
89367X2

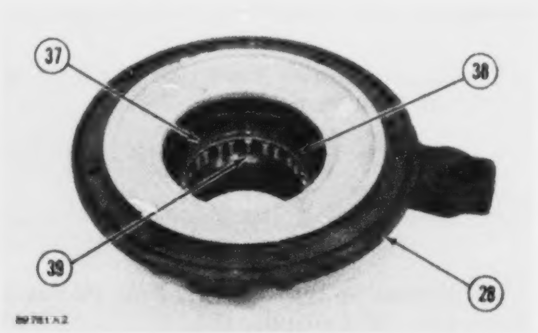
21. Remove spiral ring (35). Remove bearing (36) from bearing cage (27).


35
36
27
89365X2

22. Remove spiral ring (37). Remove bearing (38) from cage (28). Remove bearing race (39) from the bearing cage.

23. Remove sprial ring that holds bearings (40) to the input shaft. Install tooling (D). Remove gears (41) and (43) and spacer (44). Remove bearing race (42) with tooling (F).


42
41
40
D
43
44
89774X2


37
38
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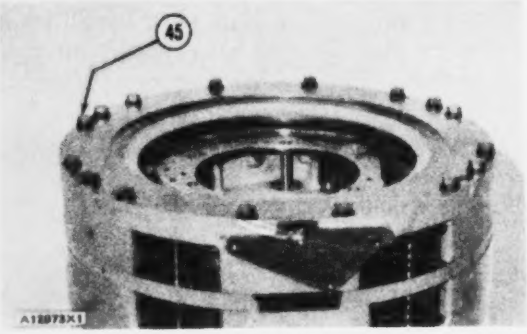
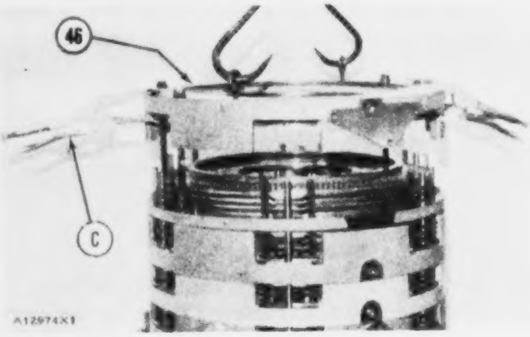
89781X2

TRANSMISSION (POWER SHIFT)

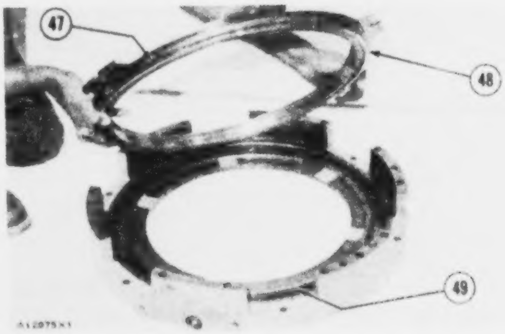
NOTE: Put identification on each of the five clutch housings as to their order and location. The housings must be installed in the correct order.



24. Remove the three bolts (45) that hold the clutch housings together.

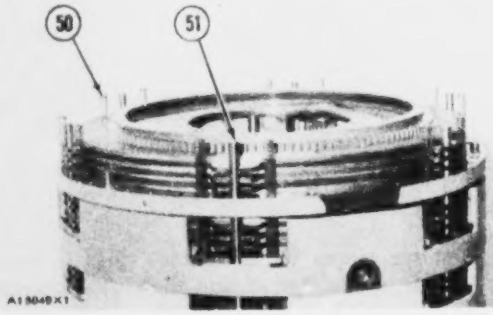


25. Install tooling (C) to keep No. 1 clutch piston in position in the No. 1 clutch housing. Remove the other three bolts.



26. Install two 3/8"–16 NC forged eyebolts in No. 1 clutch housing (46). Fasten a hoist to the clutch housing. Remove the No. 1 clutch housing and piston as a unit. Weight of the unit is 110 lb. (50 kg).

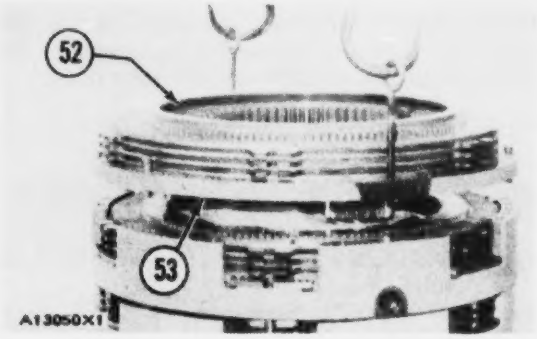
27. Turn the No. 1 clutch housing over. Remove tooling (C). Remove piston (48). Remove rings (47) and (49) from the piston and housing.



28. Remove six pins (51) and twelve springs (50).

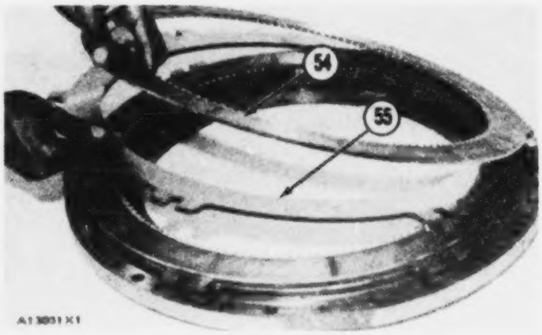
TRANSMISSION (POWER SHIFT)

29. Install two 3/8"–16 NC forged eyebolts 3 in. (76.2 mm) long in plate (53). Fasten a hoist to the plate. Remove the plate. Weight of the plate is 120 lb. (54 kg).



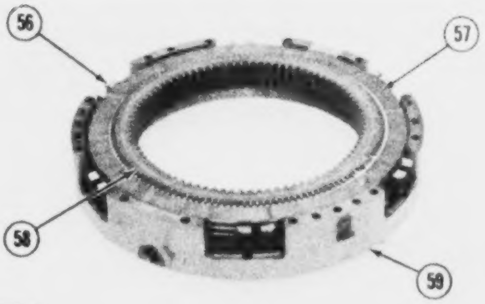
A13050X1

30. Remove ring gear (52). Remove four discs (54) and three plates (55) from No. 1 clutch housing.



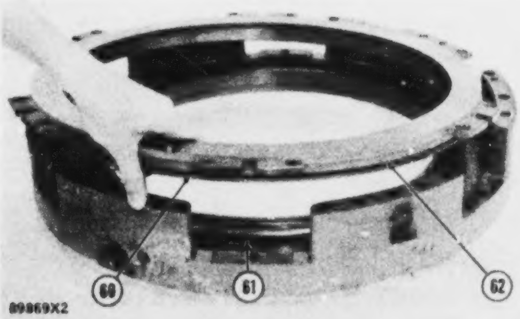
A13051X1

31. Install two 3/8"–16 NC forged eyebolts in No. 2 clutch housing. Fasten a hoist to the clutch housing. Remove the clutch housing. Weight of the clutch housing (59) is 200 lb. (91 kg).



89872X2

32. Remove ring gear (58). Remove four discs (57) and three plates (56) from No. 2 clutch housing.

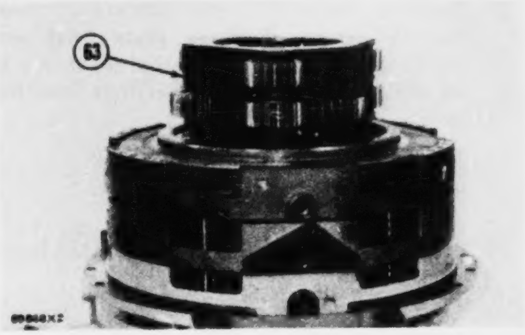


89869X2

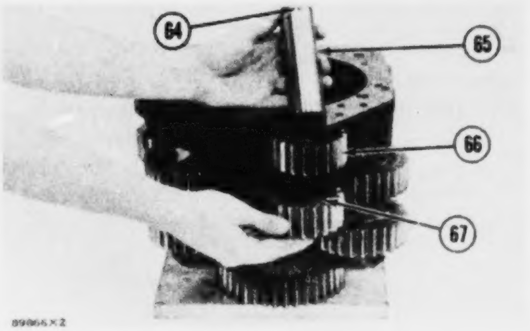
33. Remove piston (62). Remove rings (60) and (61) from the piston and the clutch housing.

TRANSMISSION (POWER SHIFT)

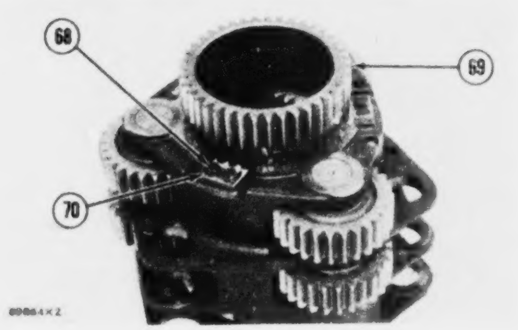
34. Install three 3/8"–16 NC forged eyebolts in No. 1 carrier. Fasten a hoist to the carrier (63). Remove the carrier. Weight of the carrier is 160 lb. (73 kg).



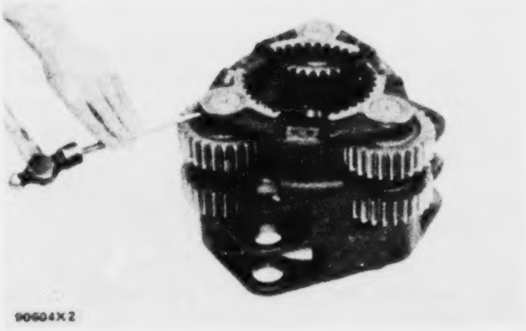
35. Remove shafts (65), gears (66) and washers (67) from the carrier. There is a washer on each side of the gear.



NOTE: Use caution to prevent loss of balls (64) when shafts (65) are removed.



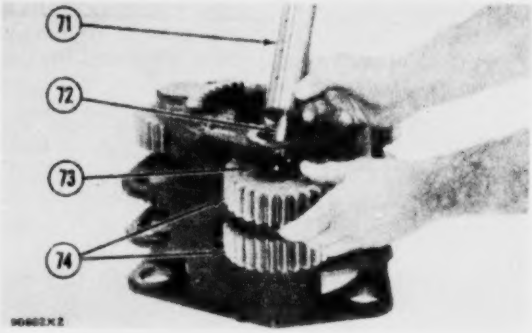
36. Turn No. 1 carrier over. Remove bolts (68), locks, and plates (70). Remove sun gear (69).



37. Remove dowels from the three shafts and carrier with a hammer and punch.

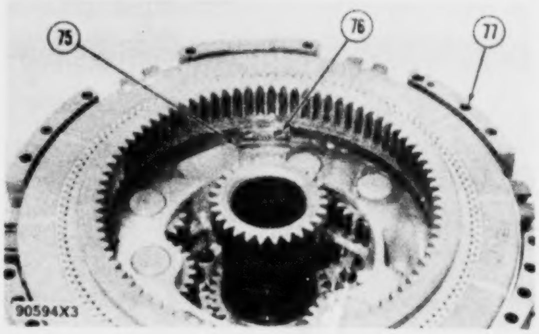
TRANSMISSION (POWER SHIFT)

38. Remove shafts (71) and tubes (72) from No. 1 carrier. Remove gears (74) and washers (73). There is a washer on each side of the gears. Remove the bearings from the gears.

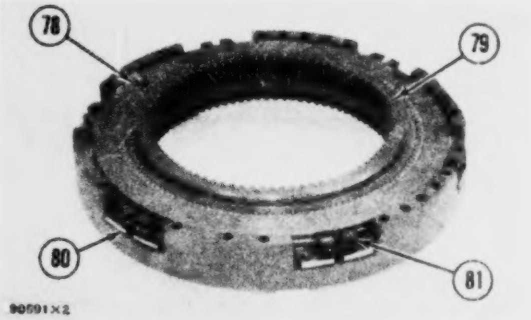


39. Remove the outer bearing race for the input shaft from the No. 1 carrier.

40. Remove bolts (76), locks, and plates (75). Install two 3/8"–16 NC forged eyebolts in No. 3 clutch housing (77). Fasten a hoist to the clutch housing. Remove the clutch housing. Weight of the clutch housing is 170 lb. (77 kg).

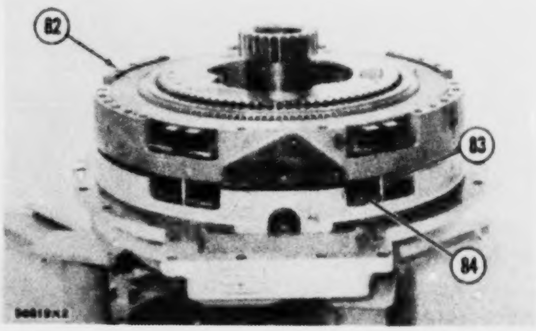


41. Remove six pins and twelve springs from the piston of the No. 4 clutch.



42. Remove ring gear (79) from No. 3 clutch housing. Remove three discs (78) and two plates (81). Remove piston (80). Remove the rings from the piston and housing.

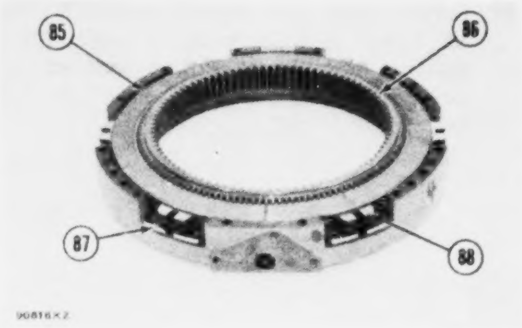
43. Install two 3/8"–16 NC forged eyebolts in No. 4 clutch housing (82). Fasten a hoist to the clutch housing. Remove the clutch housing. Weight of the clutch housing 140 lb. (64 kg).



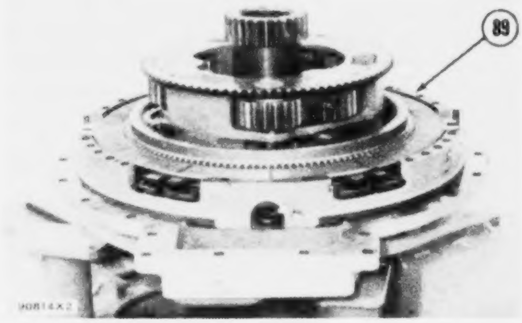
44. Remove six pins (83) and twelve springs (84).

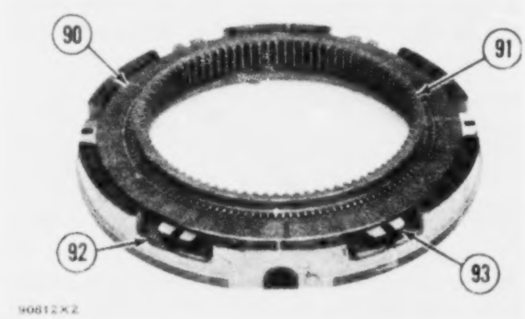
TRANSMISSION (POWER SHIFT)

45. Remove ring gear (86) from the No. 4 clutch housing. Remove three discs (85) and two plates (88). Remove piston (87). Remove the rings from the piston and housing.

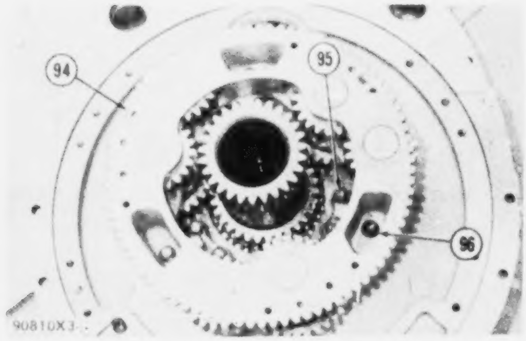


46. Install two 3/8"–16 NC forged eyebolts in No. 5 clutch housing (89). Fasten a hoist to the clutch housing. Remove the clutch housing. Weight of the clutch housing is 120 lb. (54 kg).





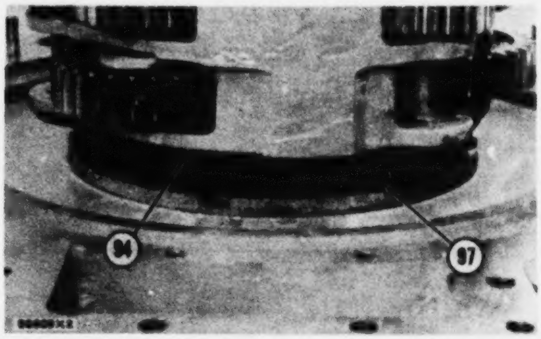
47. Remove ring gear (91) from No. 5 clutch housing. Remove two discs (90) and one plate (93). Remove piston (92). Remove the rings from the piston and clutch housing.



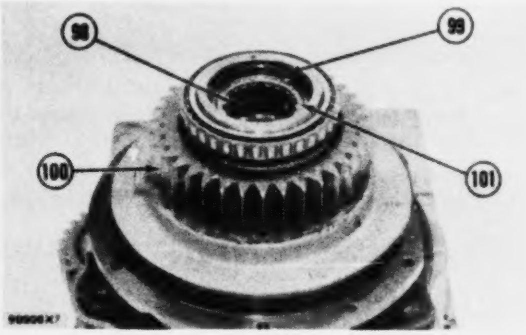
48. Remove bolts (95) and (96) that hold No. 2 carrier (94) to the transfer gear case.

TRANSMISSION (POWER SHIFT)

49. Loosen bolts (97). Install three 3/8"–16 NC forged eyebolts in No. 2 carrier (94). Fasten a hoist to the carrier. Remove the carrier. Weight of the carrier is 205 lb. (93 kg).

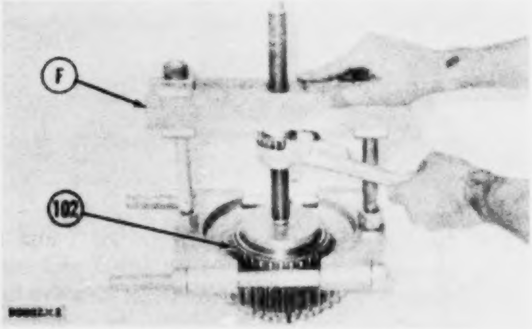


50. Remove spiral ring (99) that holds the inner bearing (101) in the carrier. Remove the inner bearing with tool (E). Remove retainer (98). Put a support under the output shaft.

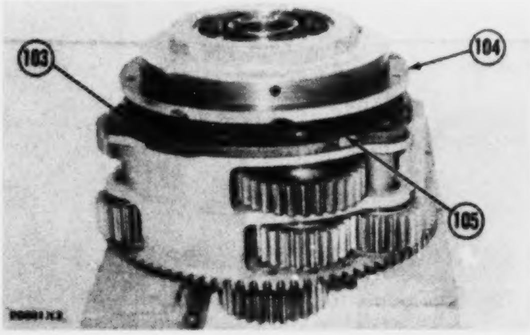


51. Remove the snap ring that holds the output shaft to the transfer gear. Remove transfer gear (100).

52. Remove the inner race and roller assemblies (102) with tooling (F).



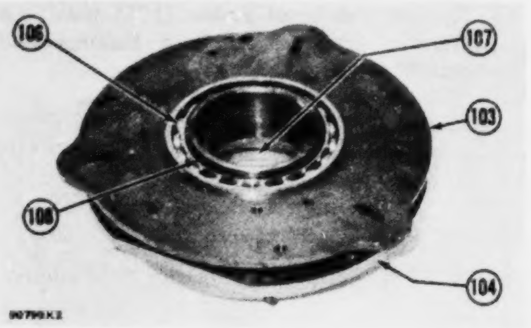
53. Remove bolts (105) that hold the bearing cages (103) and (104) to the carrier. Install three 3/8"–16 NC forcing screws in bearing cage (104). Tighten the forcing screws evenly until the cages are free. Remove the bearing cages as a unit.



TRANSMISSION (POWER SHIFT)

54. Remove sprial ring (108). Remove bearing cage (103).

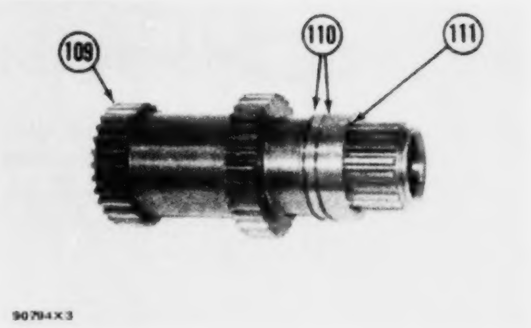
55. Remove bearing (106) from cage (103).



56. Remove the dowel from bearing cage (104). Remove bearing outer race (107) from the bearing cage.

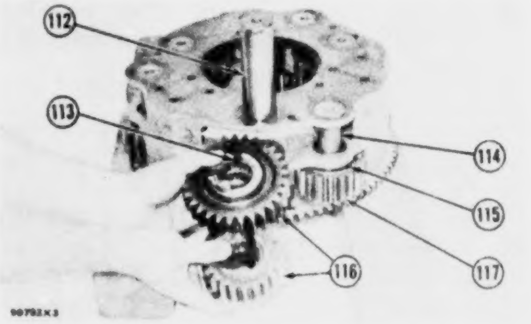
57. Remove output shaft (109) from No. 2 carrier.

58. Remove spacer (111) from the output shaft with tooling (G). Remove rings (110) from the spacer.



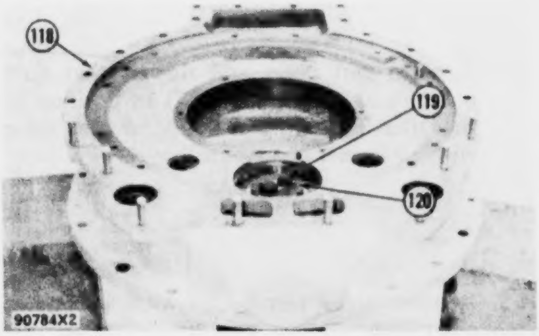
59. Remove shafts (112), gears (116) and washers (113) from No. 2 carrier. There is a washer on each side of each gear. Remove the bearings from the gears.

60. Remove shafts (114), gears (117) and washers (115). There is a washer on each side of the gears. Remove the bearings from the gears.



61. Install three 1/2"–13 NC forged eyebolts in the transfer gear case (118). Put the transfer gear case on blocks. Put a block under the bevel pinion to prevent damage when it is removed. Weight of the transfer gear case is 350 lb. (159 kg).

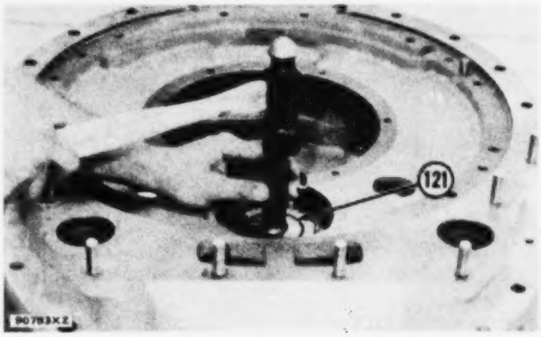
62. Remove bolts (119), lock and washer (120).



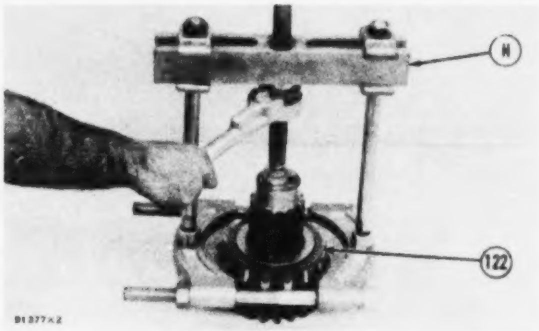
TRANSMISSION (POWER SHIFT)

63. Remove the bevel pinion (121) from the transfer gear case with a hammer and punch.

64. Remove the spacer from the bevel pinion.

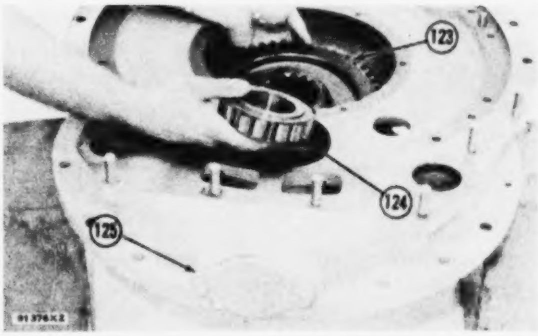

121
90783X2

65. Remove the inner race and roller assembly (122) from the bevel pinion with tooling (H).


H
122
91377X2

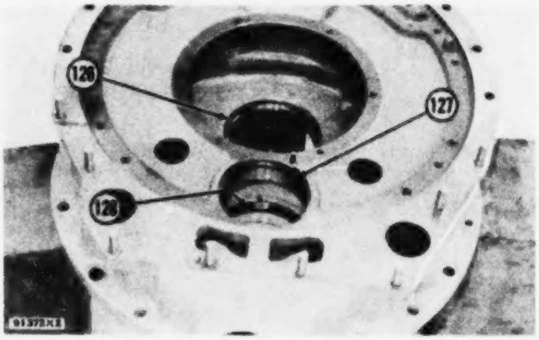
66. Remove inner race and roller assembly (124) and gear (123) from the transfer gear case.

67. Remove cover (125).


123
124
125
91376X2

68. Remove cap plugs and dowels that hold outer races (126) and (127) in position in the transfer gear case. Remove the races with a hammer and a punch.

69. Remove outer race (128) with a hammer and punch.


126
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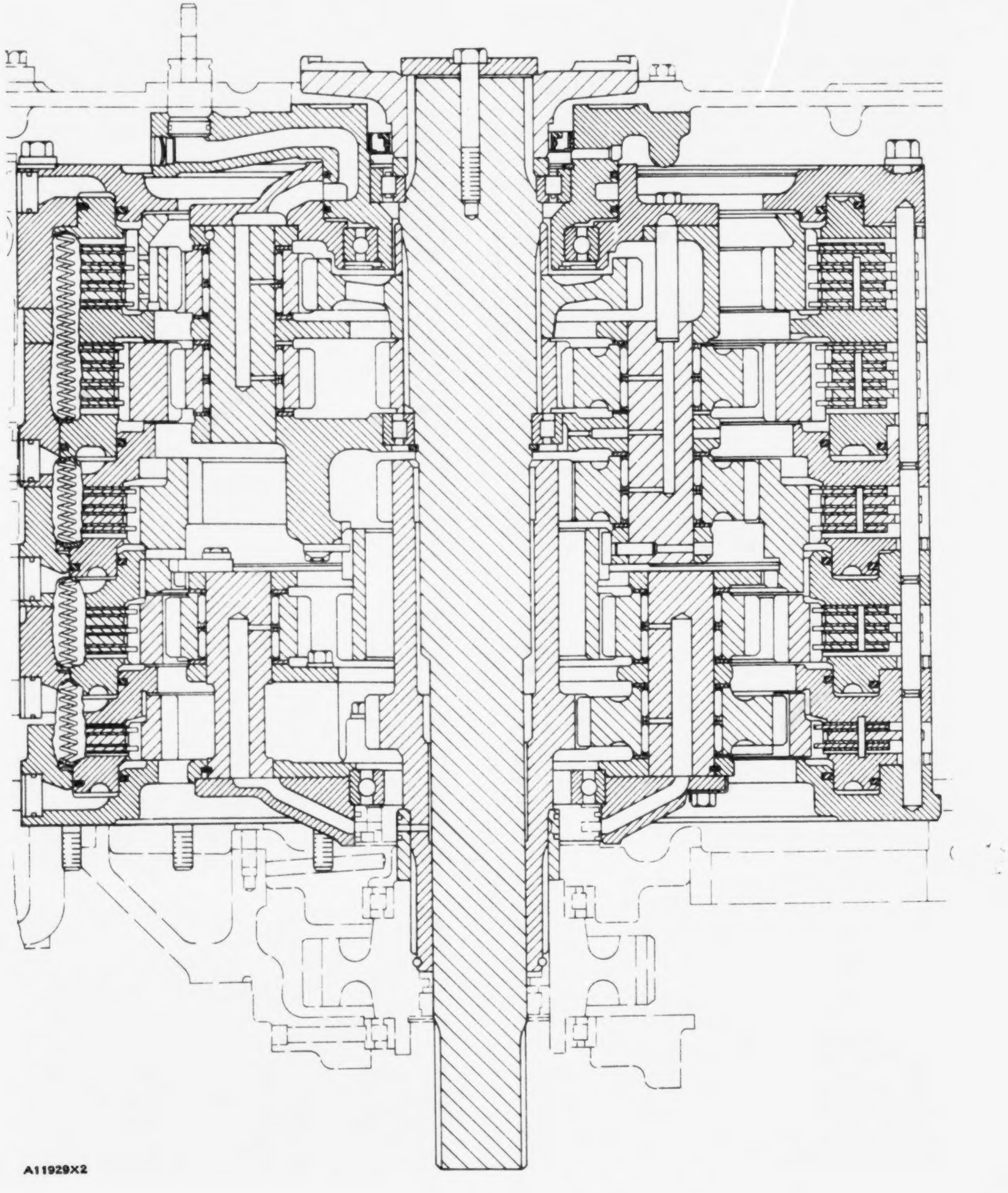
128
91372X2

TRANSMISSION (POWER SHIFT)



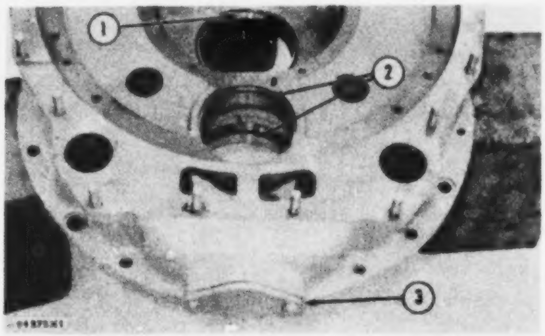
A11929X2

TRANSMISSION (POWER SHIFT)

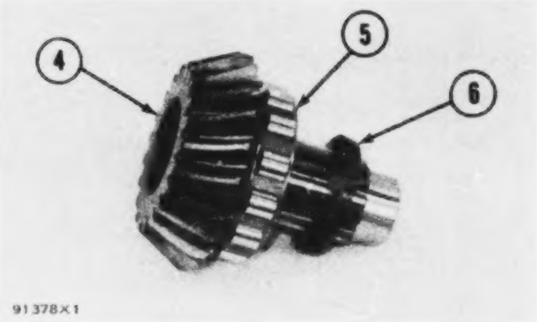
ASSEMBLE TRANSMISSION (POWER SHIFT) 16–3150

Tools Needed		A	B	C	D	E	F
1P2420	Repair Stand	1					
FT833	Clamp		2				
1P531	Handle			1			
1P524	Drive Plate			1			
1P513	Drive Plate			1			
FT834	Nozzle				1		
1P529	Handle					1	1
1P462	Drive Plate					1	
1P463	Drive Plate					1	
1P469	Drive Plate						1

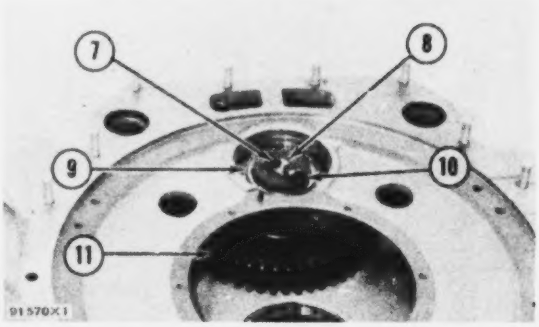
1. Lower the temperature of the bearing outer races (2) for the bevel pinion and the outer bearing race (1) for the transfer gear. Install the races in their respective locations in the transfer gear case. Put the holes in the races for the bevel pinion in alignment with their holes in the transfer gear case. Install the dowels and cap plugs in the holes.



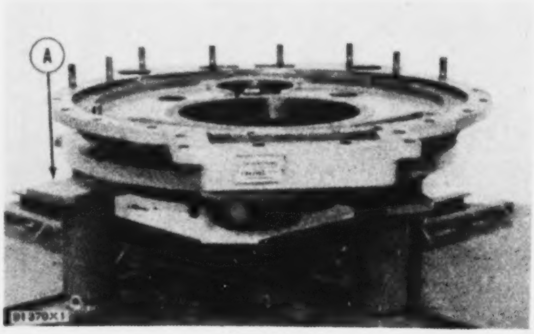
2. Install cover (3).



3. Heat inner race and roller assembly (5) in oil to a maximum temperature of 275°F (135°C). Install the inner race and roller assembly on bevel pinion (4). Install spacer (6) on the bevel pinion.



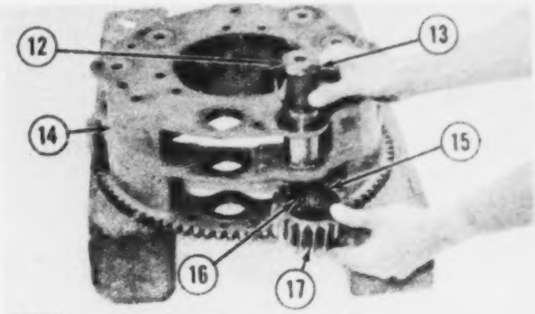
4. Put the bevel pinion, gear (11), and inner race and roller assembly (9) in position in the transfer gear case. Make sure the gear is installed with the large chamfer toward the top. Pull the inner race and roller assembly and gear on the bevel pinion with washer (10) and two 2B947 bolts. Remove the two Bolts. Install locks (8) and bolts (7).



5. Fasten a hoist to the transfer gear case. Install it on tool (A).

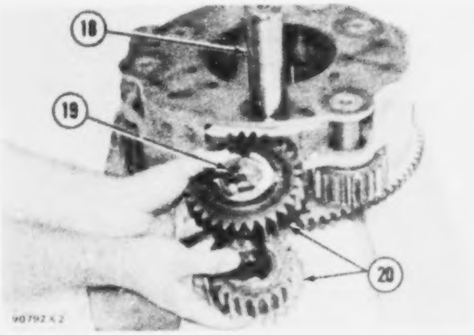
TRANSMISSION (POWER SHIFT)

6. Install bearings (16) in gears (17). Install the gears, washers (15), and shafts (12) in the No. 2 carrier (14). Make sure there is a washer on each side of the gears. Make sure the key (13) in the shaft engages in its groove in the carrier.



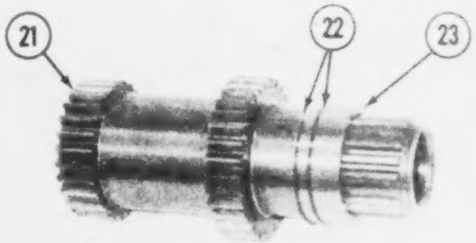
90790X1

CAUTION: Make sure the oil holes in all the shafts for the No. 2 carrier are open.



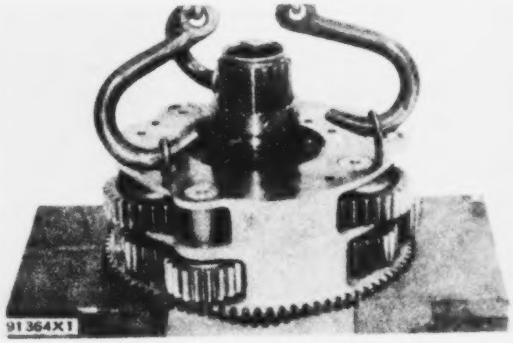
90792X2

7. Install the bearings in gears (20). Install the gears, washers (19), and shafts (18) in the No. 2 carrier. Make sure the larger gears are to the top. Make sure the key in the shaft engages in its groove in the carrier.



90794X2

8. Heat spacer (23) in oil to a maximum temperature of 275°F (135°C). Install the spacer on the output shaft (21). Install rings (22) in the spacer.



91364X1

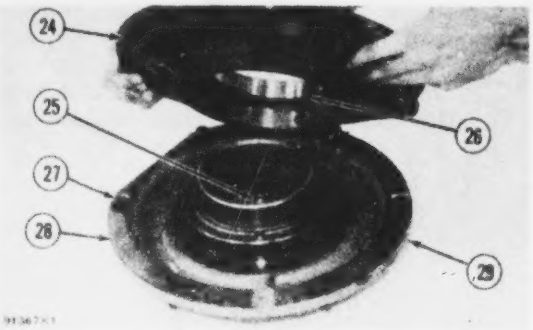
9. Fasten a hoist to the No. 2 carrier. Put the carrier in position over the output shaft. Make sure the teeth in the output shaft engage the teeth of the gears in the carrier. Put blocks under the carrier to keep the teeth engaged.

TRANSMISSION (POWER SHIFT)

10. Lower the temperature of bearing race (25). Install the race in bearing cage (29).

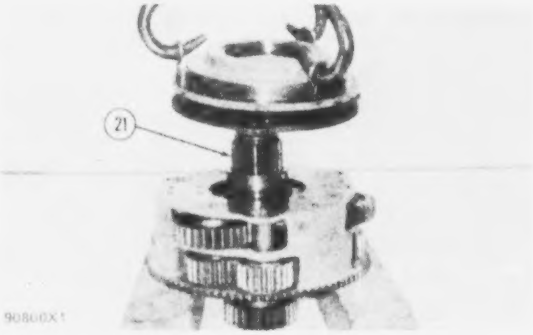
11. Install bolts (27) and locks (28) in the bearing cage as shown.

12. Lower the temperature of bearing (26). Install the bearing in bearing cage (24).



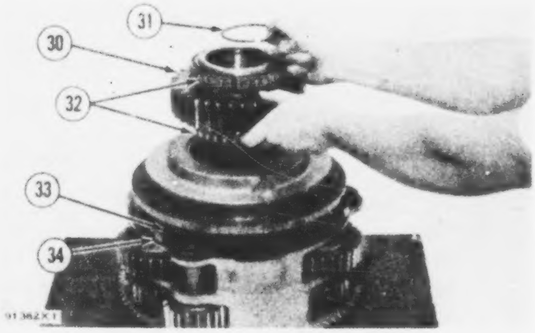
13. Install bearing cage (24) on bearing cage (29). Install the spiral ring that holds the cages together.

14. Fasten a hoist to the bearing cages. Install the cages over the output shaft (21).



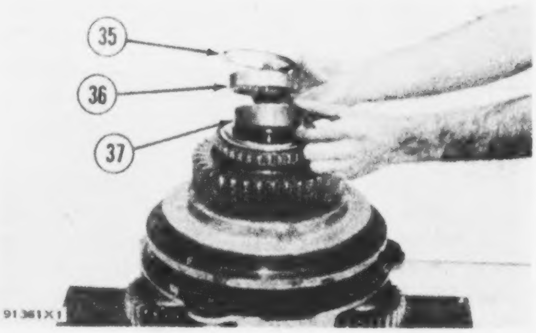
15. Install bolts (33) and locks (34) that hold the bearing cages to the carrier.

16. Heat bearings (32) in oil to a maximum temperature of 275°F (135°C). Install the bearings on transfer gear (30).



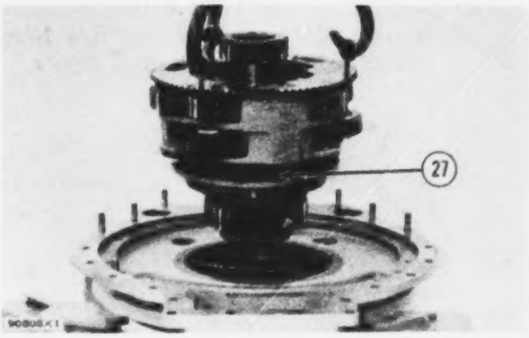
17. Install the transfer gear on the output shaft. Install snap ring (31) in its groove in the output shaft.

18. Install retainer (37), bearing (36), and sprial ring (35) in the transfer gear.

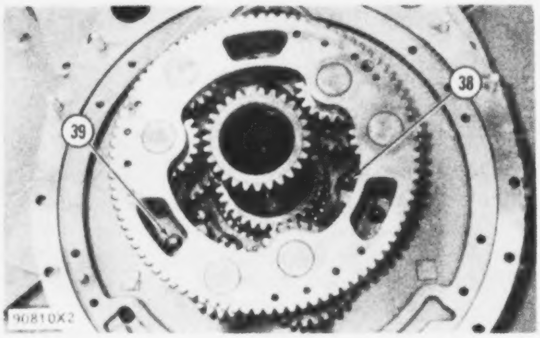


TRANSMISSION (POWER SHIFT)

19. Fasten a hoist to the No. 2 carrier. Put the carrier in position on the transfer gear case. Tighten bolts (27) the hold the bearing cage to the transfer gear case.

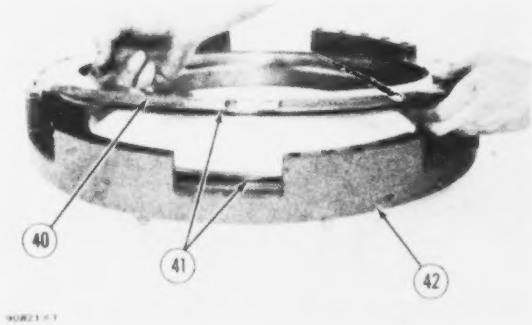


20. Install six bolts (38). Install three bolts (39). Tighten the nine bolts to a torque of 40 ± 3 lb.ft. (5.5 ± 0.4 mkg).

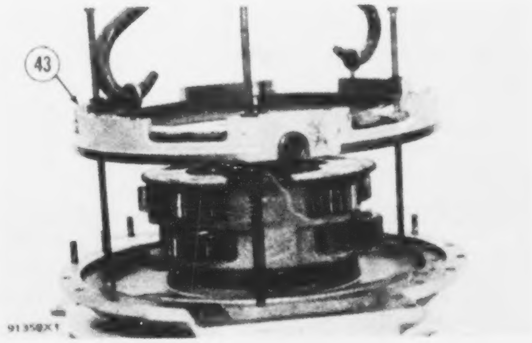


21. Install the pistons and rings in the clutch housings as follows:
    a) Put oil on the rings.
    b) Install rings (41) in pistons (40) and housings (42).
    c) Make sure the rings are in the centers of their respective grooves. Lightly push the pistons into position in the housings.

CAUTION: Be extra careful when installing the pistons in the housings. Rings with damage or broken rings can be the result of too much force being used or the pistons not being in alignment with the housings.



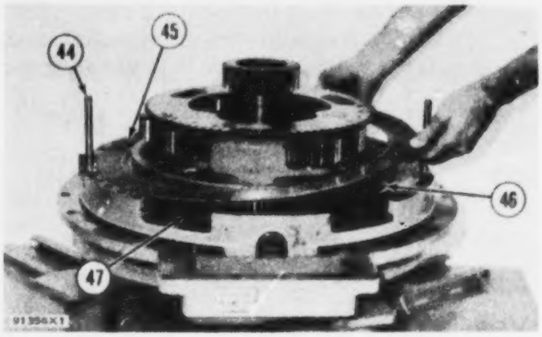
22. Fasten a hoist to the No. 5 clutch housing (43). Install the housing on the transfer gear case. Make sure the housing is in alignment with the marks made when disassembling. Use the long bolts as guide pins.



TRANSMISSION (POWER SHIFT)

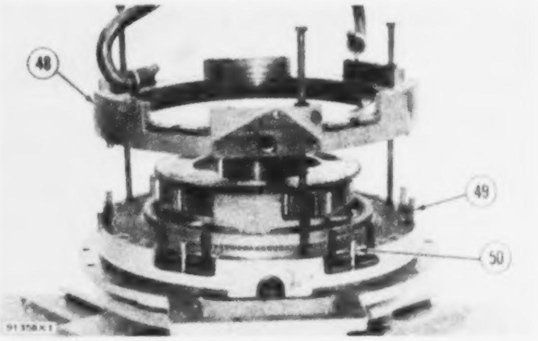
23. Install ring gear (46) in the No. 5 clutch housing. Make sure the smaller outside diameter of the ring gear is up as shown.

24. Install two of the longer pins (44) for use as guide pins. Install two dics (45) and a plate (47). Start with a disc.



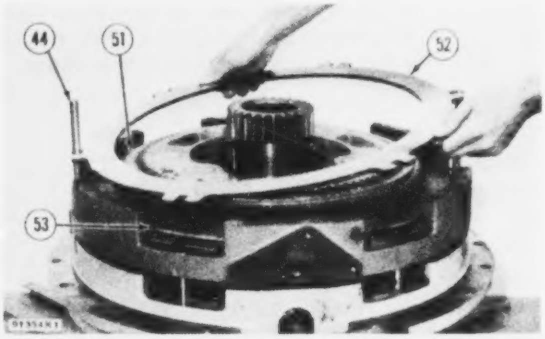
25. Remove the two long pins. Install six pins (50) and twelve springs (49).

26. Fasten a hoist to the No. 4 clutch housing (48). Put the housing in position on the No. 5 clutch housing. Make sure the pins and springs in the No. 5 clutch housing engage in their holes in the No. 4 clutch housing.



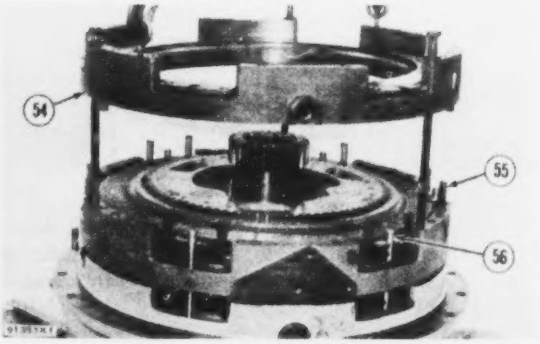
27. Install ring gear (51) with its smaller outside diameter toward the top.

28. Install two long pins (44) for use as guide pins. Install three discs (53) and two plates (52). Start with a disc.



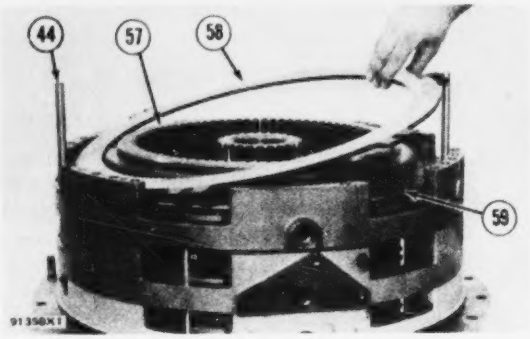
29. Remove the two long pins. Install six pins (56) and twelve springs (55).

30. Fasten a hoist to the No. 3 clutch housing (54). Put it in position on the No. 4 clutch housing. Make sure the pins and springs engage in their holes in the No. 3 clutch housing.

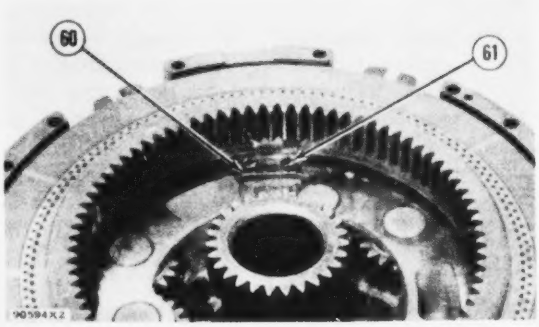


TRANSMISSION (POWER SHIFT)

31. Install ring gear (57) with its smaller outside diameter toward the top. Install two long pins (44) for use as guide pins. Install three discs (59) and two plates (58). Start with a disc. Remove the two long pins.

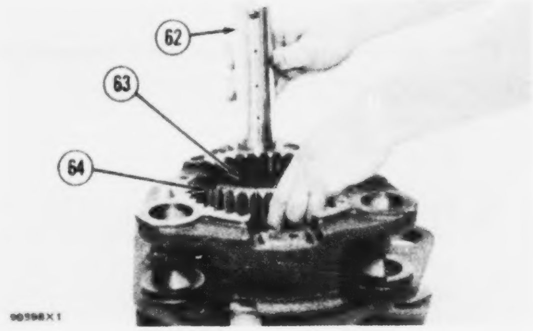


32. Install plates (60), locks, and bolts (61).



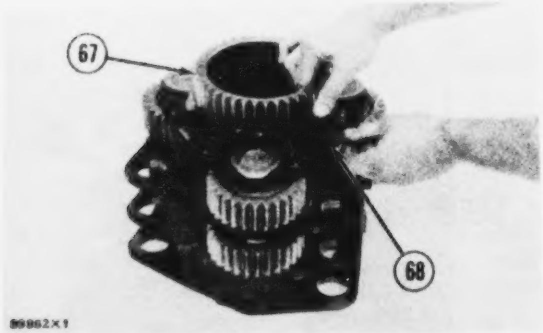
33. Lower the temperature of the bearing race (65) for the input shaft. Install the bearing race in the No. 1 carrier.

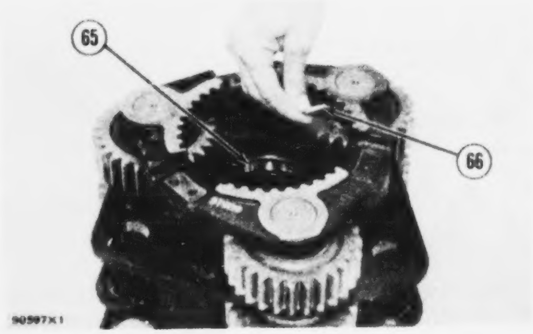
34. Install the bearings in gears (64). Install the gears, washers (63), and shafts (62) in the No. 1 carrier. There must be a washer on each side of the gears.



35. Put the holes in the shafts in alignment with the holes in the carrier. Install pins (66).

36. Put sun gear (67) in position on the carrier. Install plates (68), locks, and bolts that hold it.

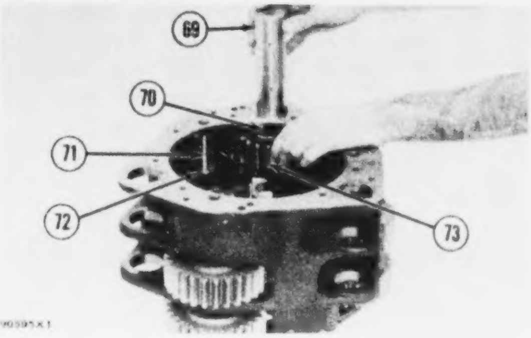




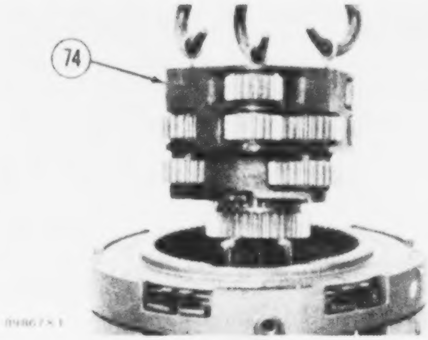
TRANSMISSION (POWER SHIFT)

37. Install tubes (71) in shafts (72).

38. Turn the carrier over. Install the bearings in gears (73). Install the gears, washers (70), and shafts (69) in the carrier. Make sure the balls in the shafts engage in the grooves in the carrier.

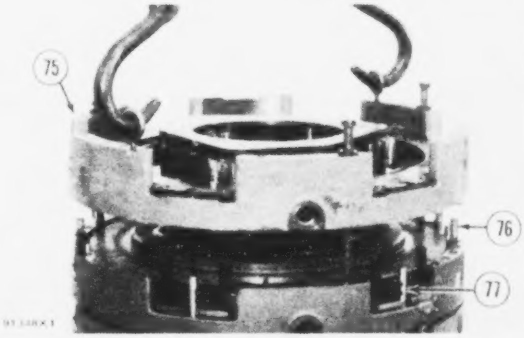


39. Install three 3/8"–16NC forged eyebolts in the No. 1 carrier (74). Fasten a hoist to the eyebolts. Install the carrier in the No. 3 clutch housing. Make sure the teeth of the sun gear engage in the teeth of the top planetary gears for the No. 2 carrier. Make sure the teeth of the lower planetary gears of the No. 1 carrier engage in the teeth of the ring gear for the No. 3 clutch.



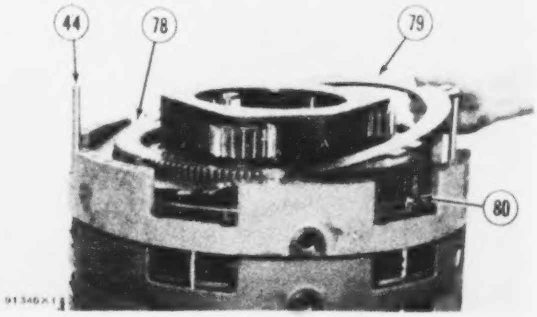
40. Install six pins (77) and twelve springs (76).

41. Fasten a hoist to the No. 2 clutch housing (75). Put it in position on the No. 3 clutch housing. Make sure the pins and springs engage in their holes in the No. 2 clutch housing.



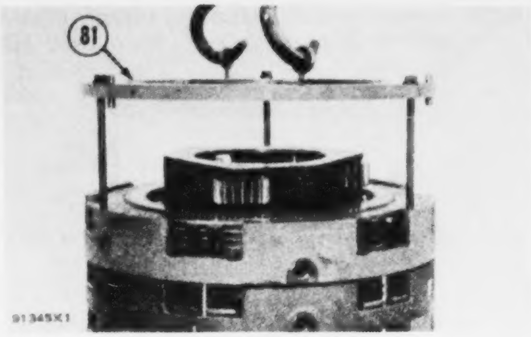
42. Install ring gear (78).

43. Install two long pins (44). Install four discs (80) and three plates (79). Start with a disc.



TRANSMISSION (POWER SHIFT)

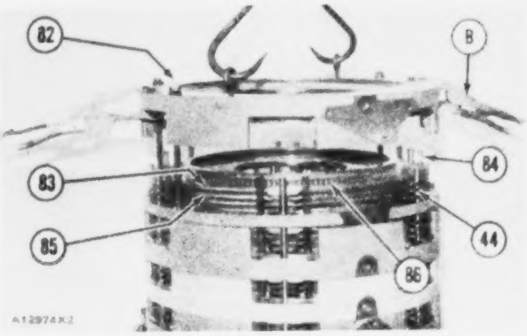
44. Fasten a hoist to plate (81). Install the plate on the No. 2 clutch housing.



45. Install four more long pins (44) and twelve springs (84).

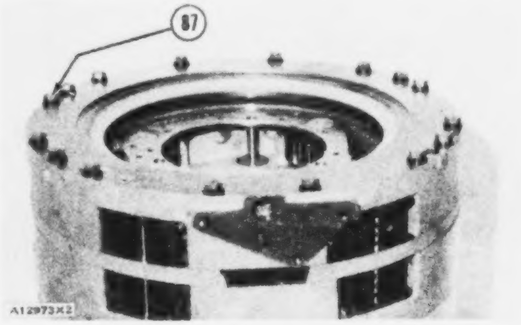
46. Install ring gear (86). Install four discs (83) and three plates (85). Start with a disc.

47. Install tooling (B) on No. 1 clutch housing (82) to hold the piston in position. Fasten a hoist to the housing and install it on the plate. Make sure the springs and pins engage in the holes in the No. 1 carrier.



48. Install bolts (87) that hold the clutch housings to the transfer gear case. Tighten the bolts to a torque of 85 ± 5 lb.ft. (11.8 ± 0.7 mkg).

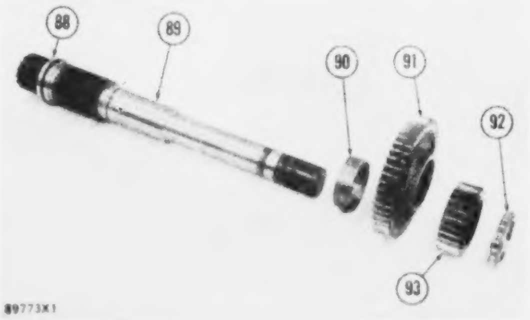
NOTE: Two of bolts (87) are shorter than the others. Install the two bolts on the side opposite from which the hydraulic controls are installed.



49. Heat bearing race (88) in oil to a maximum temperature of 275°F (135°C). Install the race on the input shaft (89).

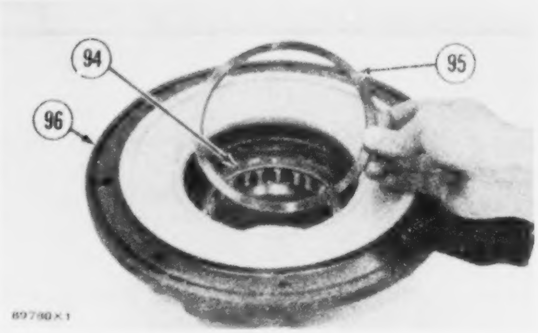
50. Install spacer (90) and gear (91) on the input shaft.

51. Heat gear (93) and bearing (92) in oil to a maximum temperature of 275°F (135°C). Install the gear and bearing on the input shaft. Install the snap ring that holds the bearing.



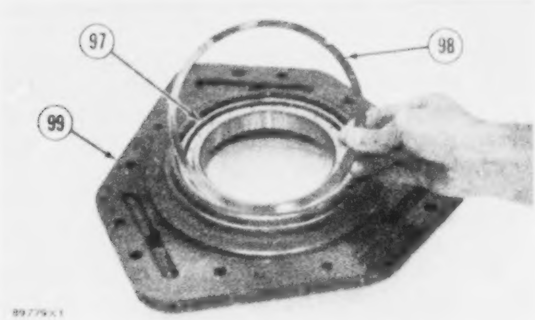
TRANSMISSION (POWER SHIFT)

52. Lower the temperature of bearing (94). Install it in bearing cage (96). Install spiral ring (95).



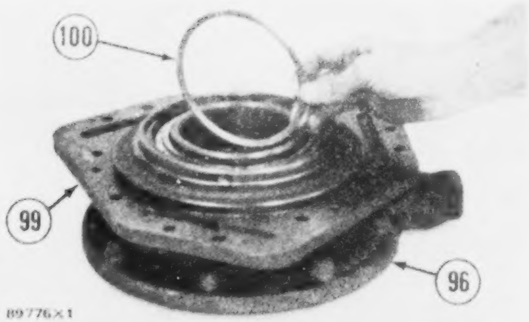
89780X1

53. Lower the temperature of bearing (97). Install it in bearing cage (99). Install spiral ring (98).



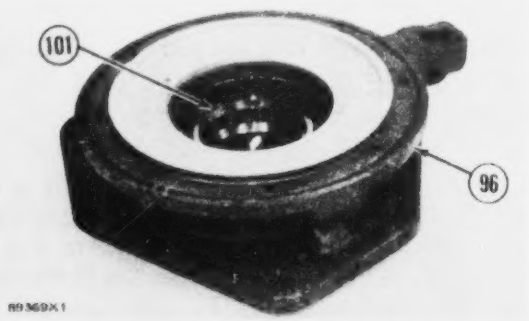
89779X1

54. Put bearing cage (99) on the bearing cage (96). Install spiral ring (100) that holds the cages together.



89776X1

55. Install spacer (101) in bearing cage (96).

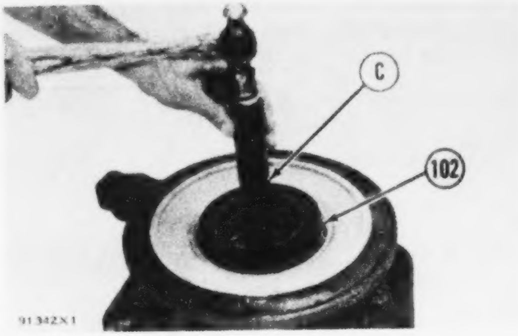


89369X1

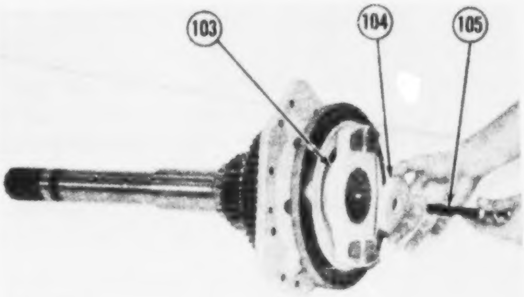
TRANSMISSION (POWER SHIFT)

56. Install lip type seal (102) in the bearing cage with tooling (C). Put clean SAE 30 oil on the rubber lip of the seal.

NOTE: Make sure seal (102) is installed with the lip of the seal toward spacer (101).

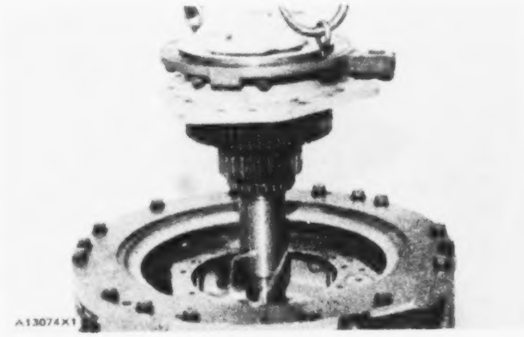


57. Install the bearing cages on the input shaft as shown. Install flange (103). Install retainer (104) and bolt (105). Tighten the bolt to a torque of 85 ± 5 lb.ft. (11.8 ± 0.7 mkg).

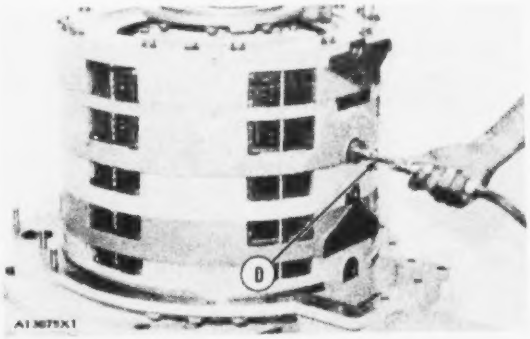


58. Fasten a hoist to the input shaft. Install the input shaft in the transmission. Make sure the gear on the input shaft is in alignment with the gear in No. 1 carrier.

59. Install the bolts and locks that hold the input shaft in position.



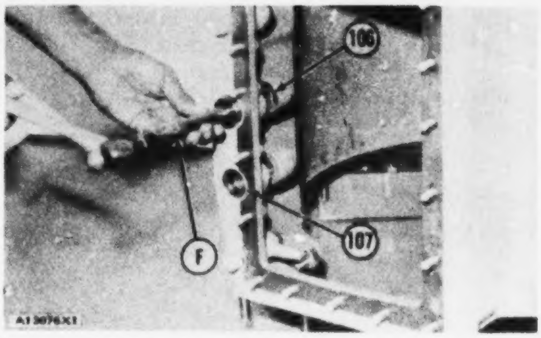
60. Check to make sure the pistons are free in their clutch housings as follows:
    a) Put air (free of water) under a pressure of 100 to 150 psi (7.3 to 105. kg/cm^2) into the five oil passages with tool (D).
    b) There must be .12 to .25 in. (3.0 to 6.4 mm) of travel for each piston.
    c) If the pistons do not move the distance in Step 60(b), put a small amount of oil in the five passages. Follow procedure in Step 60(a). If the pistons still do not move, the transmission must be disassembled and the pistons checked.



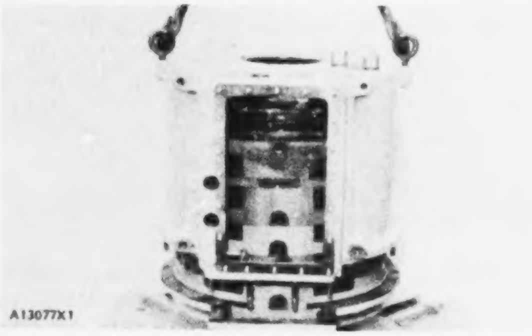
TRANSMISSION (POWER SHIFT)

61. Install two bearings (106) in the case with tooling (E). Install the bearings even with the top surface of the case.

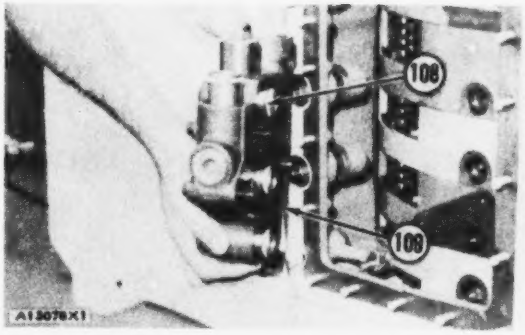
62. Install the two seals (107) in the case with tooling (F).



63. Fasten a hoist to the case. Put the case in position on the transfer gear case. Install the nuts and washers that hold the transmission case to the transfer gear case.



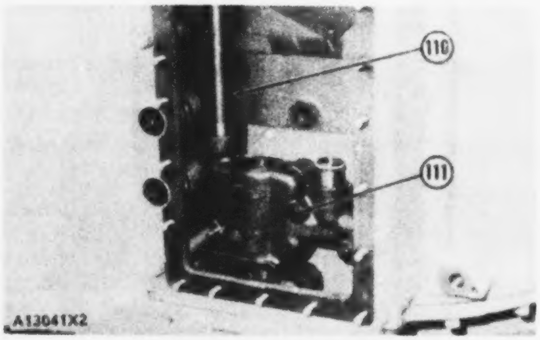
64. Install the bolts that hold the bearing cages of the output shaft to the transmission case.



65. Put clean SAE 30 oil on seals (108). Put the sleeves in selector valve (109). Put the selector valve in position in the transmission.

66. Install bolts (111) that hold the selector valve in position. Tighten the bolts to a torque of 35 ± 3 lb.ft. (4.8 ± 0.4 mkg).

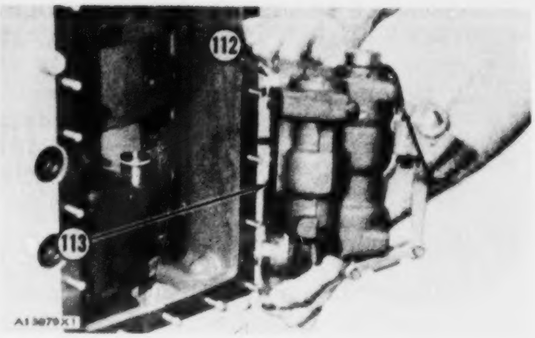
67. Put clean SAE 30 oil on seals for tube (110). Put the tube in the transmission case and into the selector valve.



TRANSMISSION (POWER SHIFT)

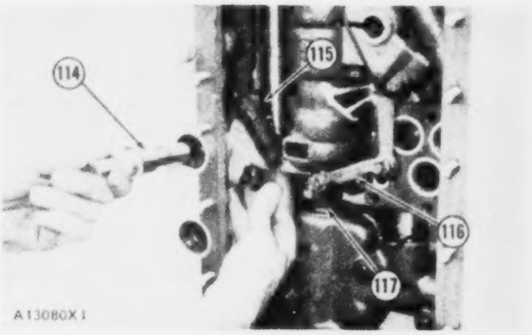
68. Put clean SAE 30 oil on seals (112). Install the sleeve in the directional valve (113). Put the directional valve in position in the transmission. Install the two tubes in the directional valve.

69. Install the bolts that hold the directional valve in position. Tighten the bolts to a torque of 35 ± 3 lb.ft. (4.8 ± 0.4 mkg).



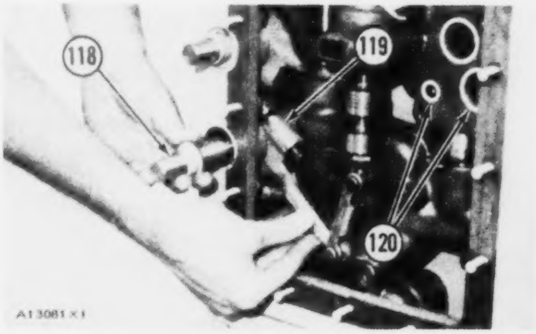
70. Put lever (115) in position. Install shaft (114). Tighten the bolt on lever (115).

71. Install the link assembly (116) in the selector valve. Tighten nut (117).



72. Put lever (119) in position. Install shaft (118). Tighten the bolt on lever (119).

73. Install seals (120).

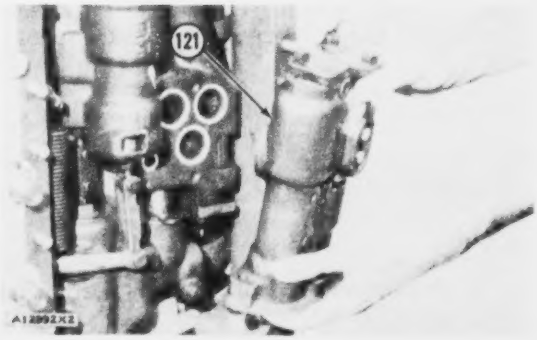


74. Put pressure control valve (121) in position in the transmission. Install the bolts that hold it. Tighten the bolts to a torque of 35 ± 3 lb.ft. (4.8 ± 0.4 mkg).

75. Install the priority valve on the transmission.

76. Install the cover over the transmission hydraulic controls.

end by:
    a) install transmission

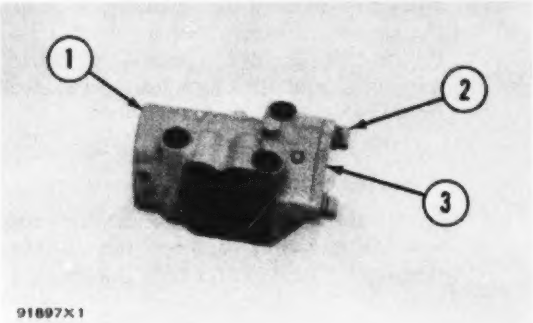


TRANSMISSION HYDRAULIC CONTROL VALVES (POWER SHIFT)

DISASSEMBLE TRANSMISSION HYDRAULIC CONTROLS 15–3152 & 3157

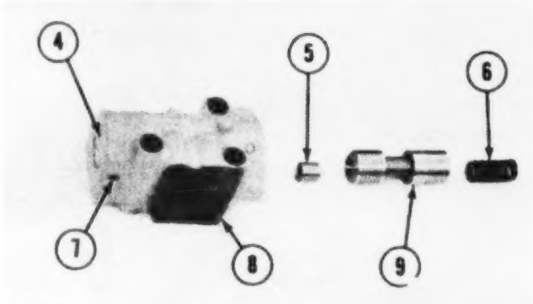
start by:

a) remove transmission hydraulic controls See, DISASSEMBLE TRANSMISSION (POWER SHIFT)



91897X1

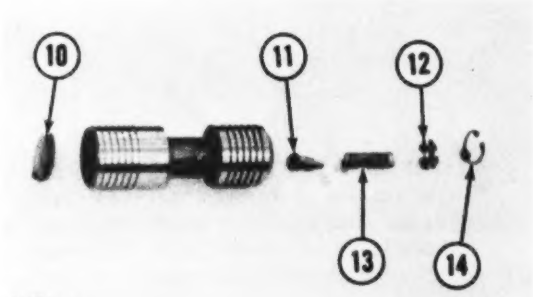
1. Disassemble priority valve (1) as follows:



91898X1

a) Cover (3) is under spring tension. Hold the cover in position and remove bolts (2). Remove the cover.

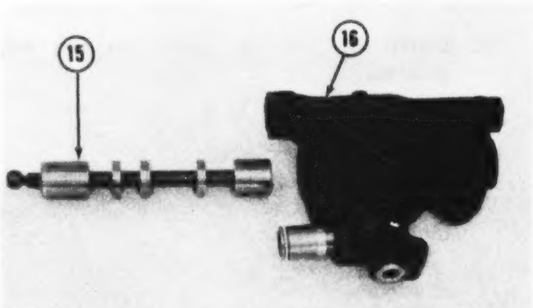
b) Remove spring (6) and valve spool (9). Remove slug (5) from the spool.



91599X1

c) Remove dowel (7) from body (8). Remove stop (4).

d) Remove spacers (10) from the spool. Remove snap ring (14), retainer (12), spring (13) and plunger (11) from the spool.



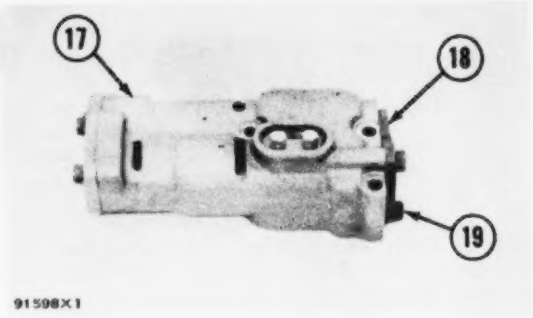
89378X1

2. Remove valve spool (15) from selector valve (16).

TRANSMISSION HYDRAULIC CONTROL VALVES (POWER SHIFT)

3. Disassemble pressure control valve (17) as follows:

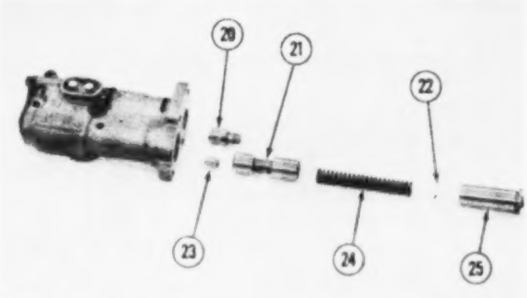
a) Remove bolts (19) and cover (18).



91598X1

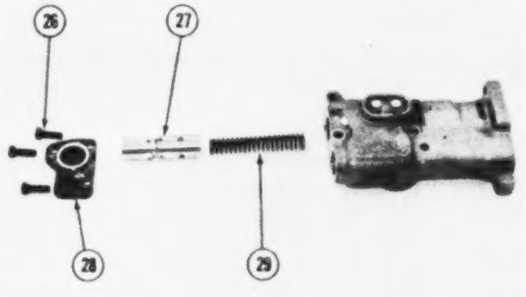
b) Remove piston (25) and spring (24). Remove spacers (22) from the piston.

NOTE: Keep spacers (22) with piston (25) to prevent mixing at assembly. The spacers are used for the adjustment of the pressure control valve.



91596X1

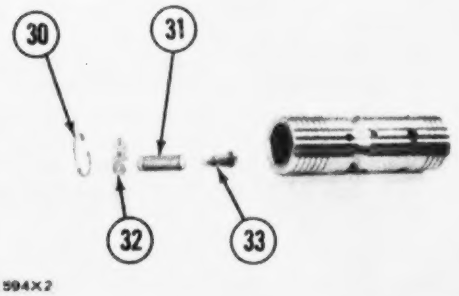
c) Remove valve spool (21). Remove slug (23) from the spool. Remove the snap ring, retainer, and plunger from the spool.



91595X2

d) Remove check valve (20) from the body.

e) Remove bolts (26) and cover (28). Remove valve spool (27) and spring (29). Remove the retainer from the body with a soft punch. Remove snap ring (30), retainer (32), spring (31) and plunger (33) from the spool.

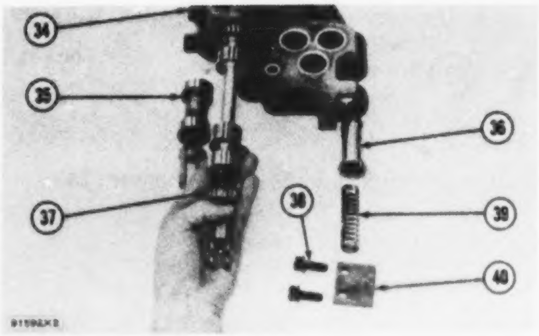


91594X2

TRANSMISSION HYDRAULIC CONTROL VALVES (POWER SHIFT)

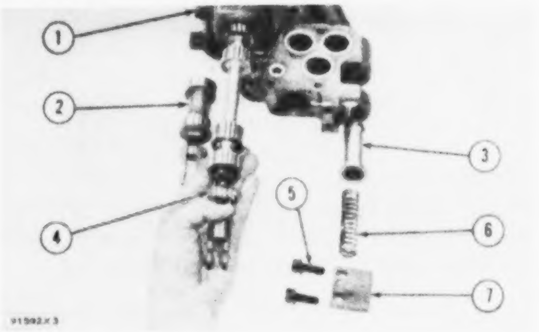
4. Disassemble directional valve (34) as follows:
   - a) Remove valve spool (37) from the housing.
   - b) Cover (40) is under spring tension. Hold the cover in position and remove bolts (38). Remove the cover. Remove spring (39) and valve (36). Remove the spacers from the valve.

NOTE: Keep the spacers with valve (36). The spacers are for an adjustment to the inlet relief pressure of the torque converter oil.

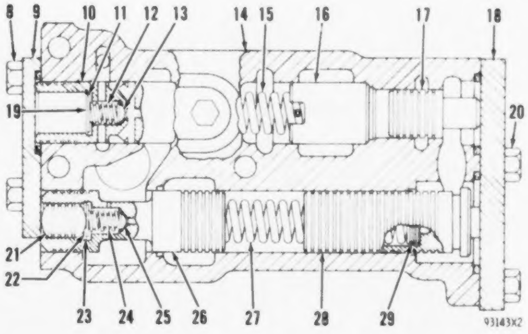


ASSEMBLE TRANSMISSION HYDRAULIC CONTROLS 16–3152 & 3157

1. Assemble directional control valve (1) as follows:
   - a) Make sure all of the parts of the directional control valve are clean and free of dirt. Put clean SAE 30 oil on the parts of the directonal control valve.
   - b) Install spacers, valve (3), spring (6) and cover (7). Install bolts (5) that hold the cover in position.
   - c) Install valve spool (4) in the housing.
   - d) Install valve spool (2) in the housing.

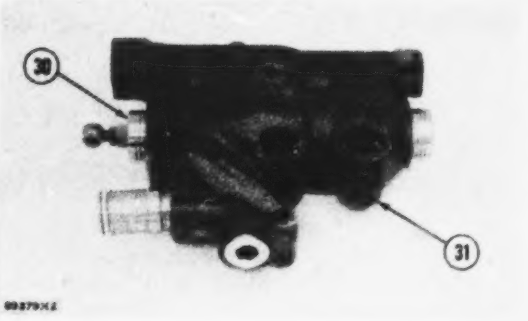


2. Assemble the pressure control valve as follows:
   - a) Make sure all of the parts of the pressure control valve are clean and free of dirt. Put clean SAE 30 oil on the parts of the pressure control valve.
   - b) Install retainer (16) in body (14). Install plunger (13), spring (12) and retainer (11) in valve spool (10). Install snap ring (19). Install the valve spool and spring (15) in the body. Install cover (9) and bolts (8). Tighten the bolts to a torque of 35 ± 3 lb.ft. (4.8 ± 0.4 mkg).
   - c) Install check valve (17) in the body.
   - d) Install plunger (25), spring (24), retainer (23) and snap ring (22) in valve spool (26).
   - e) Install slug (21) in spool (26). Install the spool and spring (27) in the body.
   - f) Install spacers (29) in piston (28). Install the piston in the body. Install cover (18) and bolts (20). Tighten the bolts to a torque of 35 ± 3 lb.ft. (4.8 ± 0.4 mkg).



TRANSMISSION HYDRAULIC CONTROL VALVES (POWER SHIFT)

3. Install valve spool (30) in selector valve (31).



4. Assemble the priority valve as follows:

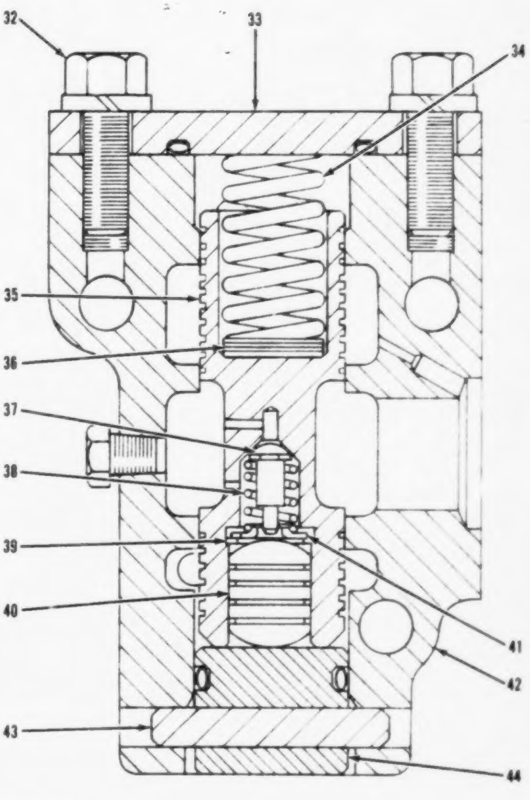
   a) Install plunger (37), spring (38), retainer (41) and snap ring (39) in valve spool (35).

   b) Install slug (40) in the valve spool.

   c) Install stop (44) in body (42). Install dowel (43) that holds it in position.

   d) Install spacers (36) in the valve spool. Install the spool and spring (34) in the body.

   e) Install cover (33) and bolts (32).



5. Make adjustments to the transmission hydraulic controls after the transmission is installed in the machine. See, POWER SHIFT TRANSMISSION TESTING AND ADJUSTING.

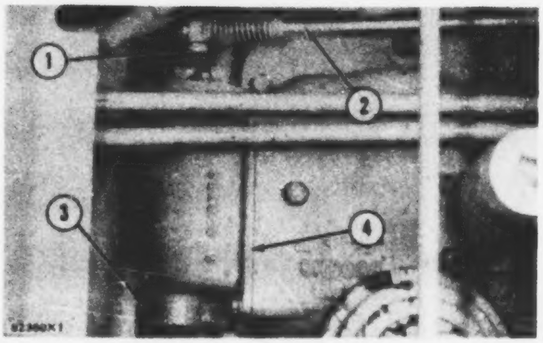
INTERLOCK MECHANISM (DIRECT DRIVE)

REMOVE INTERLOCK MECHANISM (DIRECT DRIVE) 11–3070

1. Fasten a hoist to the seat and remove it from the seat frame assembly.

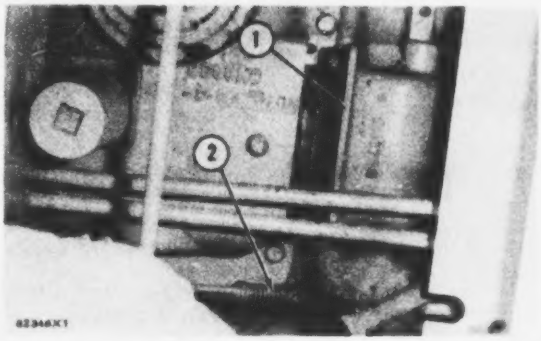
2. Disconnect the linkage (2) from the lever (1).

3. Remove bolts (3). Remove the interlock mechanism (4).



INSTALL INTERLOCK MECHANISM (DIRECT DRIVE) 12–3070

1. Put the interlock mechanism (1) in position on the transmission cover and install the bolts that hold it.
2. Connect the linkage (2) to the lever on the interlock mechanism.
3. Fasten a hoist to the seat and install it on the seat frame assembly.



NOTE: Make an adjustment to the linkage for the interlock mechanism. See LINKAGE ADJUSTMENT in TESTING AND ADJUSTING.

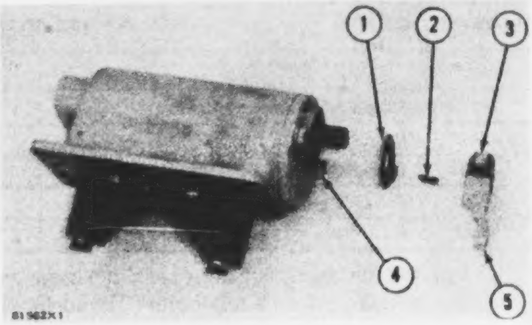
INTERLOCK MECHANISM (DIRECT DRIVE)

DISASSEMBLE INTERLOCK MECHANISM (DIRECT DRIVE) 15–3070

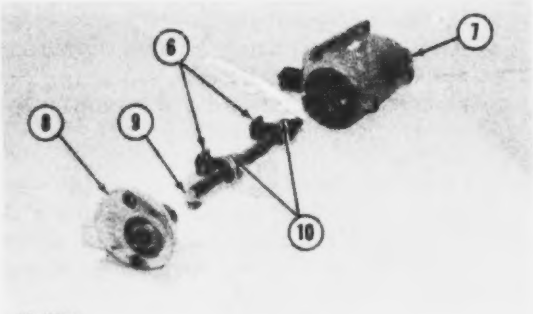
	Tools Needed	A
1P529	Handle	1
1P462	Drive Plate	1
1P459	Drive Plate	1

start by:
a) remove interlock mechanism

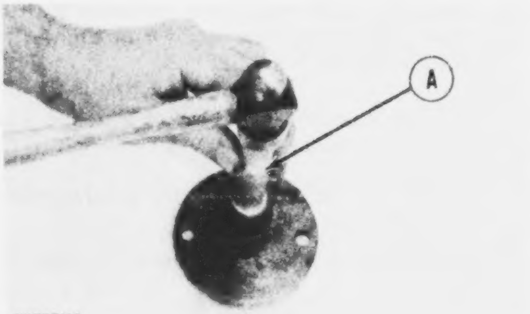
1. Loosen bolt (3). Remove lever (5), key (2), and washer (1) from the shaft.
2. Remove bolts (4).



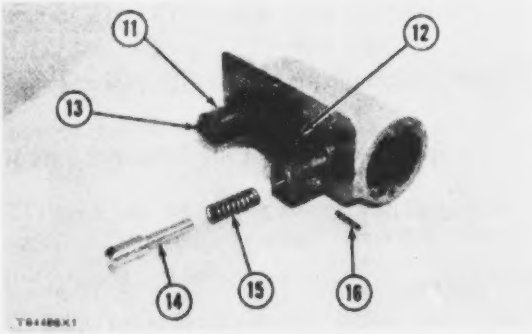
3. Remove the cover (8) and shaft assembly (9) from the housing (7). Remove pins (10) and cams (6) from the shaft. Put a mark on the cams as to their location on the shaft to prevent mixing at assembly.



4. Remove the bearing and seal from the cover with tooling (A).



5. Remove the pin (16), plunger (14), and spring (15) for forward and reverse from the plunger housing.
6. Remove the pin, plunger (13), and spring for the speed selector.
7. Remove bolts (12) and locks. Remove the plunger housing (11).

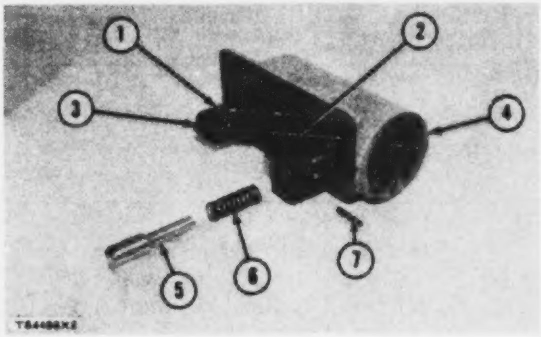


INTERLOCK MECHANISM (DIRECT DRIVE)

ASSEMBLE INTERLOCK MECHANISM (DIRECT DRIVE) 16–3070

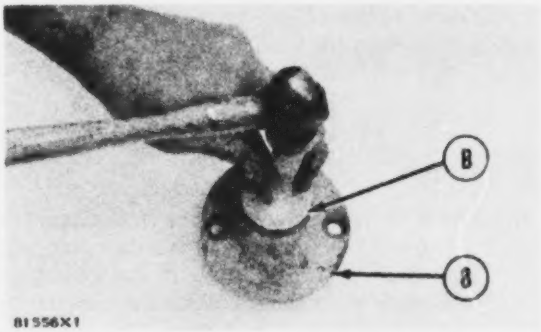
Tools Needed		A	B
1P529	Handle	1	1
1P477	Drive Plate	1	
1P460	Drive Plate	1	
1P462	Drive Plate		1
1P459	Drive Plate		1

1. Put the plunger housing (1) in position on the housing (4). Install bolts (2) and locks that hold it.

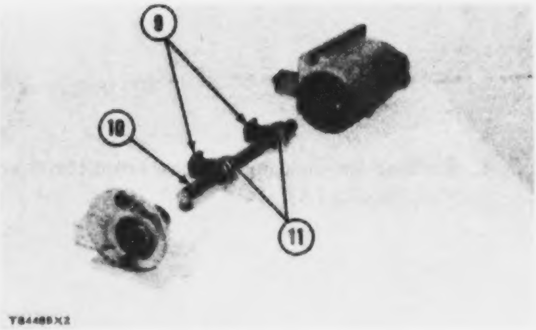


2. Put the spring and plunger (3) for the speed selector in the plunger housing. Install the pin that holds it. Put the spring (6) and plunger (5) for forward and reverse in the plunger housing. Install the pin (7).

3. Install the bearing in the cover (8) with tooling (B). Install the seal in the cover with tooling (A). Put a light amount of oil on the rubber lip of the seal to prevent damage when installing.



4. Install the cams (9) on the shaft (10). Make sure the larger slopes on the cams are toward the groove for the key in the shaft. Install the two pins (11).



NOTE: If a new cam or shaft is to be installed, use the following procedure:

a) Put the hole in the cam in alignment with the hole in the shaft.

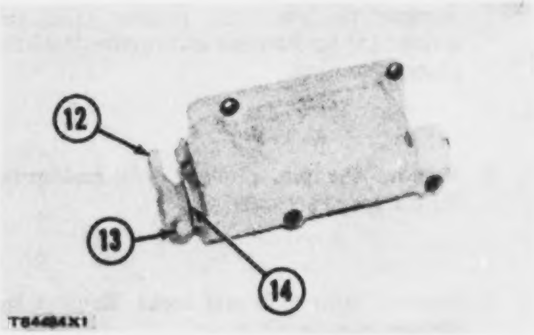
b) Make sure the larger slope on the cam is toward the groove for the key in the shaft.

c) Make a larger hole (ream) through the cam and shaft with a .219 in. (5.56 mm) diameter drill.

d) Install the pin through the cam and shaft.

5. Put the shaft with its cams in the housing. Install the cover and the bolts that hold it.

6. Install the washer (14), key, and lever (12) on the shaft. Tighten the bolt (13).



end by:
a) install interlock mechanism

FLYWHEEL CLUTCH OIL PUMP (DIRECT DRIVE)

REMOVE FLYWHEEL CLUTCH OIL PUMP (DIRECT DRIVE) 11–3056

1. Remove the floor plates from above the oil pump.

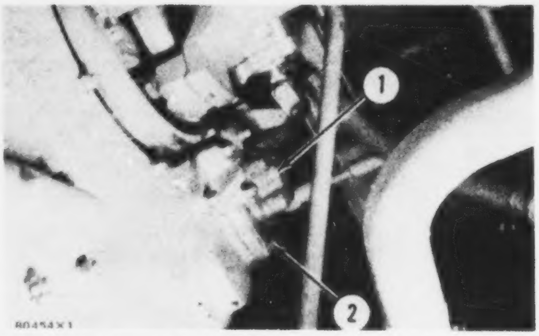


PHOTO IS A VIEW FROM UNDER MACHINE FOR BETTER ILLUSTRATION

2. Remove bolts (2). Remove the oil pump (1) for the flywheel clutch.

INSTALL FLYWHEEL CLUTCH OIL PUMP (DIRECT DRIVE) 12–3056

1. Put the oil pump (1) in position on the flywheel clutch. Make sure the teeth of the oil pump gear are in alignment with the teeth of its idler gear in the flywheel clutch. Install the bolts that hold it.

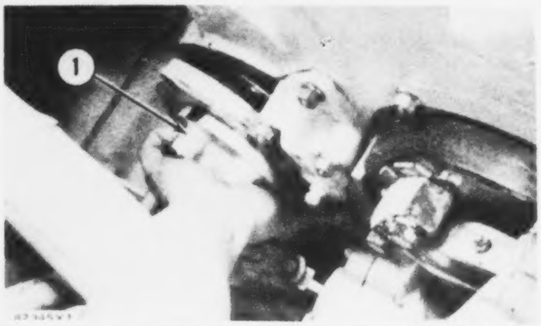


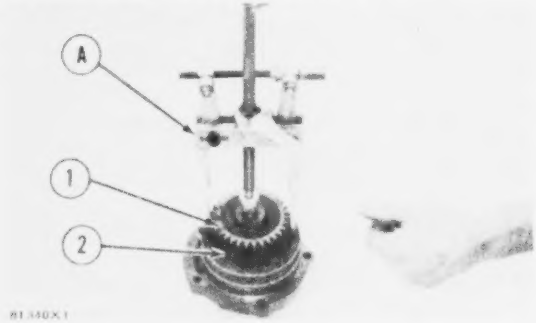
PHOTO IS A VIEW FROM UNDER MACHINE FOR BETTER ILLUSTRATION

2. Install the floor plates above the oil pump.

DISASSEMBLE FLYWHEEL CLUTCH OIL PUMP (DIRECT DRIVE) 15–3056

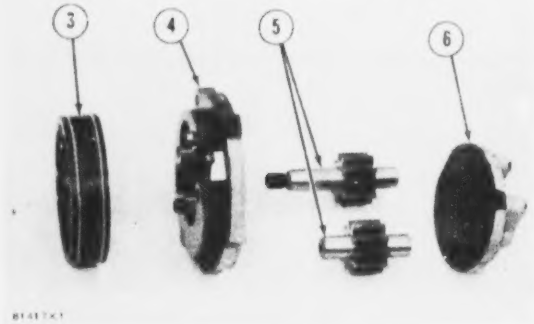
Tools Needed		A
8B7554	Puller Assembly	1
5F7345	Screw	1
9S9155	Step Plate	1
1B4209	Nut	1
4B4285	Washer	1

start by:
a) remove flywheel clutch oil pump



1. Remove the cotter pin, nut, and washer from the shaft of the gear.

2. Remove the gear (1) with tooling (A). Remove the key from the shaft of the gear.



3. Remove the bolts (2). Remove the front cover (3) from the body (4). Remove the body from the rear cover (6). Remove the two gears (5) from the rear cover.

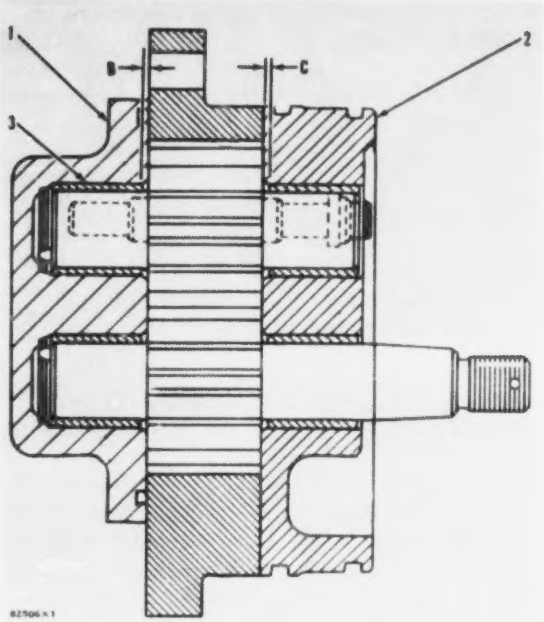
4. Remove the bearings from the front and rear covers.

FLYWHEEL CLUTCH OIL PUMP (DIRECT DRIVE)

ASSEMBLE FLYWHEEL CLUTCH OIL PUMP (DIRECT DRIVE) 16–3056

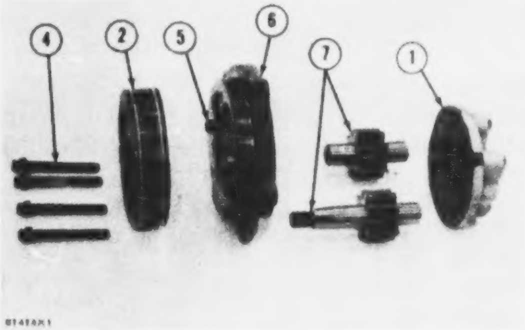
Tools Needed		A
1P529	Handle	1
1P463	Drive Plate	1
1P461	Drive Plate	1

NOTE: Put a light amount of oil on the inner components of the pump before assembling.

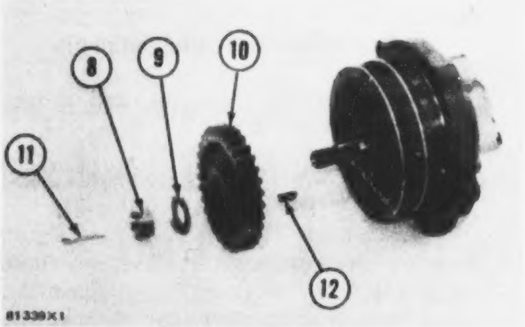


1. Install bearings (3) in covers (1) and (2) with tooling (A). Make sure dimensions (B) and (C) are .062 in. (1.57 mm).

NOTE: If the dowels (5) in the body were removed, install the dowels so their outer faces are .25 ± .02 in. (6.4 ± 0.5 mm) past the faces of the body.



2. Install the two gears (7) in the rear cover (1). Install the body (6) on the rear cover. Install the front cover (2) on the body. Install bolts (4) that hold the pump together.



3. Install the key (12) in the shaft of the gear. Put the groove in the gear (10) in alignment with the key. Install the gear on the shaft. Install the washer (9) and nut (8) on the shaft. Tighten the nut to a torque of 40 ± 4 lb.ft. (5.5 ± 0.6 mkg). Tighten the nut to put the hole in the shaft in alignment with the groove in the nut. Install the cotter (11).

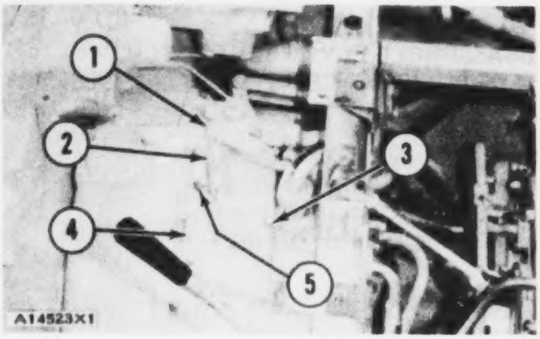
NOTE: The pump must turn freely by hand after assembly.

end by:
a) install flywheel clutch oil pump

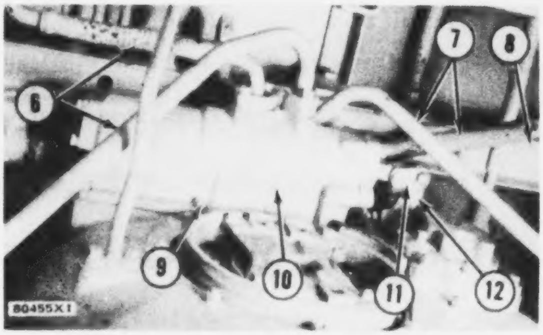
FLYWHEEL CLUTCH HYDRAULIC CONTROL MECHANISM (DIRECT DRIVE)

REMOVE FLYWHEEL CLUTCH HYDRAULIC CONTROL MECHANISM (DIRECT DRIVE) 11–3057

NOTE: The dash is removed for better illustration of the flywheel clutch hydraulic control mechanism. Photo 80455X1 is a view from under the machine. The universal joint is removed for better illustration.

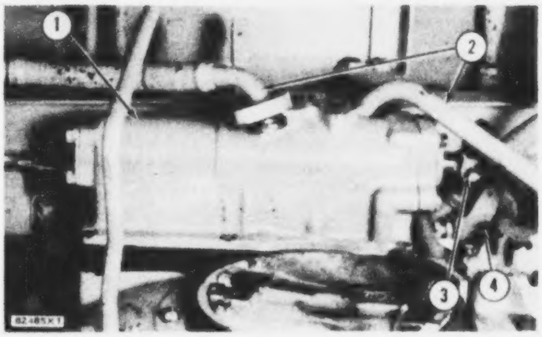


1. Remove the floor plates.
2. Remove spring (2) and lever (1). Remove bolts (3) and nut (5). Remove cover (4).
3. Remove the bolts and lock that hold the flywheel clutch hydraulic control mechanism in position.
4. Disconnect oil lines (6) and (7).
5. Disconnect valve spool links (11) from bellcrank lever (12).
6. Remove nuts (9). Remove the flywheel clutch hydraulic control mechanism (10).

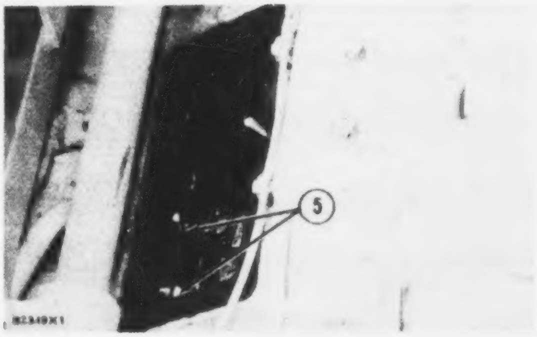


INSTALL FLYWHEEL CLUTCH HYDRAULIC CONTROL MECHANISM (DIRECT DRIVE) 12–3057

NOTE: Photo 82485X1 is a view from under the machine. The universal joint is removed for better illustration.



1. Put the flywheel clutch hydraulic control mechanism (1) over the studs on the cover for the flywheel clutch. Make sure the end of the lever engages in the coupling of the mechanism.
2. Connect the four oil lines (2) to the flywheel clutch hydraulic control mechanism.
3. Connect valve spool links (3) to the bellcrank lever (4).
4. Install bolts (5) and locks that hold the flywheel clutch hydraulic control mechanism in position.
5. Install the cover over the opening in the flywheel clutch cover. Install the lever and spring on the cover.
6. Install the floor plates.

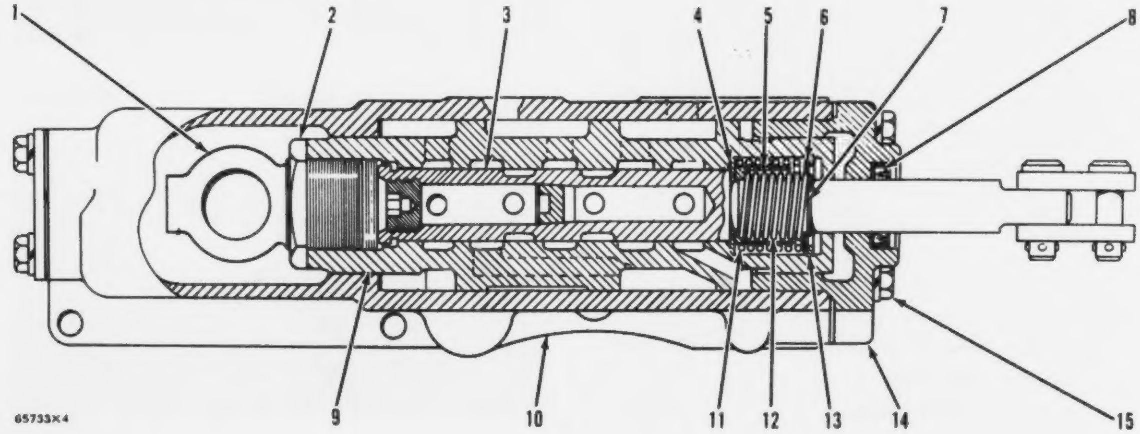


FLYWHEEL CLUTCH HYDRAULIC CONTROL MECHANISM (DIRECT DRIVE)

DISASSEMBLE FLYWHEEL CLUTCH HYDRAULIC CONTROL MECHANISM (DIRECT DRIVE) 15–3057

start by:
- a) remove flywheel clutch hydraulic control mechanism

1. Remove bolts (15) and cover (14).
2. Remove seal (8) from the cover.
3. Remove the valve spool (3) and piston (9) as a unit from the body (10).
4. Loosen nut (2). Remove the nut and coupling (1) as a unit from the piston.
5. Remove the snap ring (13) from the groove in the bore of the piston.
6. Put springs (11) and (12) under compression.
7. Remove the snap ring (7) from its groove on the valve spool.
8. Remove washer (6). Remove the two springs. Remove spacer (5). Remove washer (4).
9. Remove the valve spool from the piston.

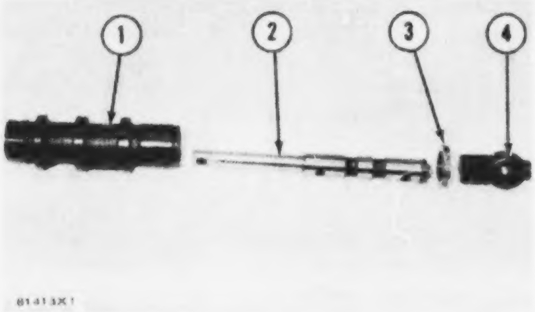


FLYWHEEL CLUTCH HYDRAULIC CONTROL MECHANISM (DIRECT DRIVE)

ASSEMBLE FLYWHEEL CLUTCH HYDRAULIC CONTROL MECHANISM (DIRECT DRIVE) 16–3057

	Tools Needed	A
1P529	Handle	1
1P479	Drive Plate	1
1P462	Drive Plate	1

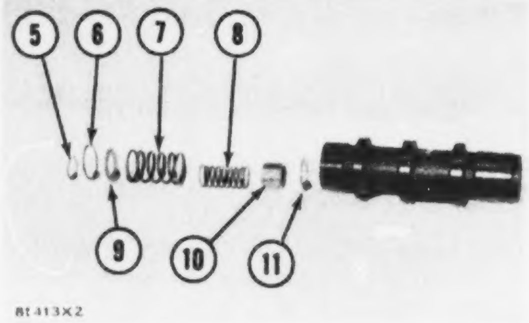
1. Install the valve spool (2) in the piston (1). Put the nut (3) on the coupling (4). Install the nut and coupling as a unit in the piston.



81413X1

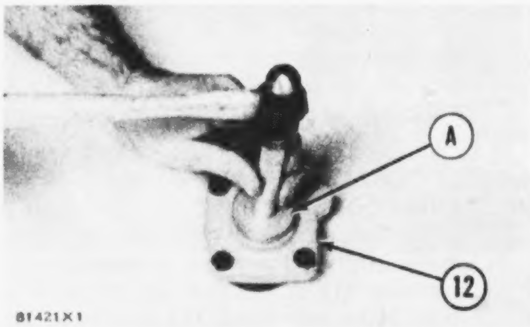
2. Install the washer (11), spacer (10), springs (8) and (7), and washer (9) over the valve spool in the piston.

3. Put the springs under compression. Install the snap ring (5) in its groove on the valve spool. Install the snap ring (6) in its groove in the piston.



81413X2

4. Install the seal in the cover (12) with tooling (A). Install the rubber lip of the seal so it will be toward the body when the cover is installed.

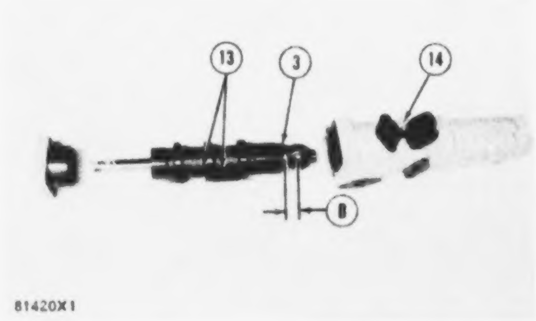


81421X1

5. Make an adjustment to the valve and piston so that the distance (B) between the center of the hole in the coupling and the face of the piston is 1.28 ± .03 in. (32.5 ± 0.8 mm). Put the hole in the coupling in alignment with the holes (13) in the piston. Tighten the nut (3).

6. Install the valve and piston as a unit in the body.

7. Install the cover and the bolts that hold it.



81420X1

end by:
a) install flywheel clutch hydraulic control mechanism

GEARSHIFT & INTERLOCK MECHANISM COVER ASSEMBLY (DIRECT DRIVE)

REMOVE GEARSHIFT & INTERLOCK MECHANISM COVER ASSEMBLY (DIRECT DRIVE) 11–3070

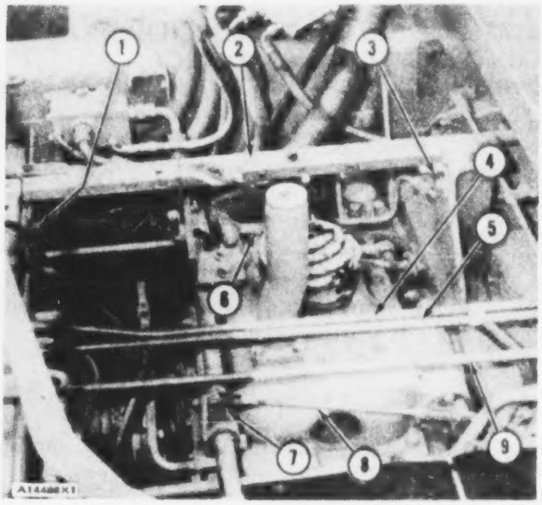
start by:
a) remove seat and seat frame

1. Remove the floor plates.

2. Remove the forward-reverse selector lever and the speed selector lever gearshift and interlock mechanism cover assembly.

3. Remove bolts (1) and (3). Remove seat frame support (2).

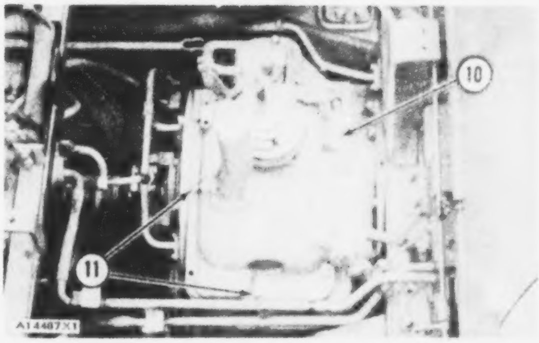
4. Remove rods (4) and (5). Remove rod (9). Disconnect rod (8) from lever (7).



5. Disconnect rod (6) from the lever.

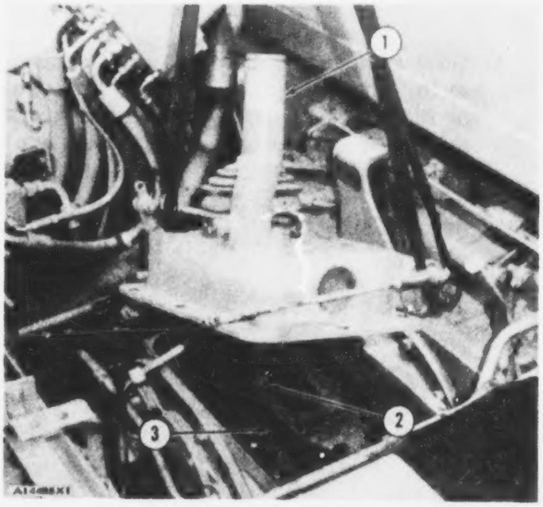
6. Remove bolts (11) and washers that hold gearshift and interlock mechanism cover assembly (10) in position.

7. Fasten a hoist to the to the gearshift and interlock mechanism cover assembly and remove it. Weight of the gearshift and interlock mechanism cover assembly is 155 lb. (70 kg).



INSTALL GEARSHIFT & INTERLOCK MECHANISM COVER ASSEMBLY 12–3070

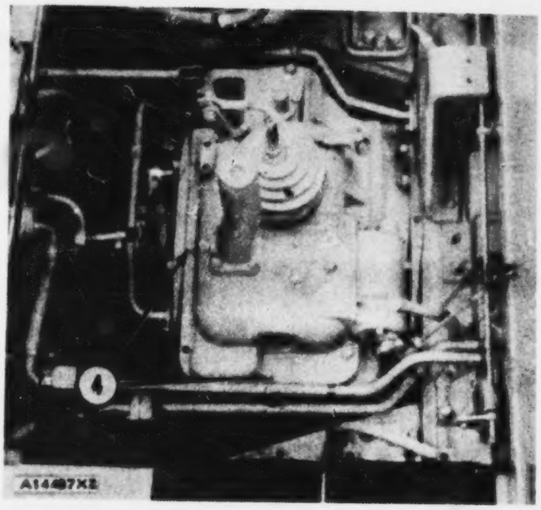
1. Put gearshift and interlock mechanism cover assembly (1) in position on the transmission. Make sure block (2) engages in fork (3). Make sure the speed selector arm engages in the holes of the speed selector gate.



GEARSHIFT & INTERLOCK MECHANISM COVER ASSEMBLY (DIRECT DRIVE)

2. Install bolts (4) that hold the gearshift and interlock mechanism cover assembly to the transmission.

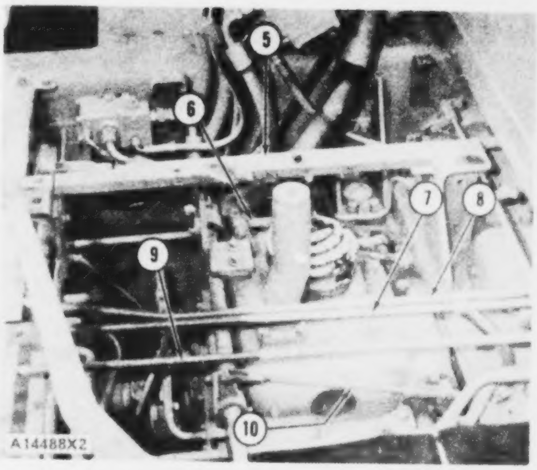
3. Install seat frame support (5). Install the bolts that hold it.



4. Connect rod (6) to the lever.

5. Install rods (7), (8), and (9) for the steering clutches and brakes.

6. Connect rod (10) to the lever.



7. Make an adjustment to the control linkage for the interlock mechanism and flywheel clutch. See LINKAGE ADJUSTMENT in TESTING AND ADJUSTING.

8. Install floor plates.

   end by:
   a) install seat and seat frame

GEARSHIFT & INTERLOCK MECHANISM COVER ASSEMBLY (DIRECT DRIVE)

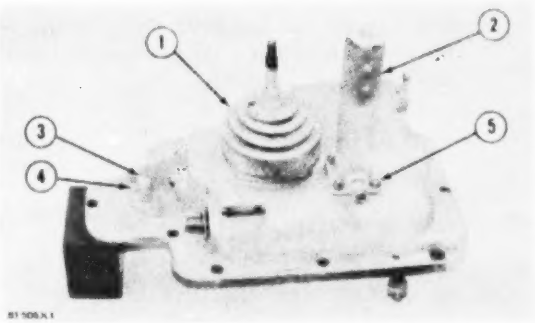
DISASSEMBLE GEARSHIFT AND INTERLOCK MECHANISM COVER ASSEMBLY (DIRECT DRIVE) 15–3070

Tools Needed		A
1P3075	Puller Group	1

start by:

a) remove gearshift and interlock mechanism cover assembly

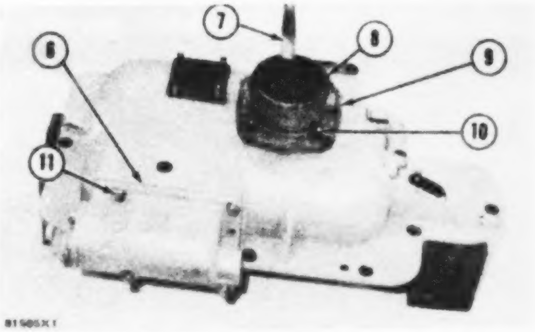
1. Remove nuts (5) and the oil filler spout (2).



81506X1

2. Remove nuts (4) and the plunger assembly (3). Remove the pin, plunger, and spring from the plunger housing.

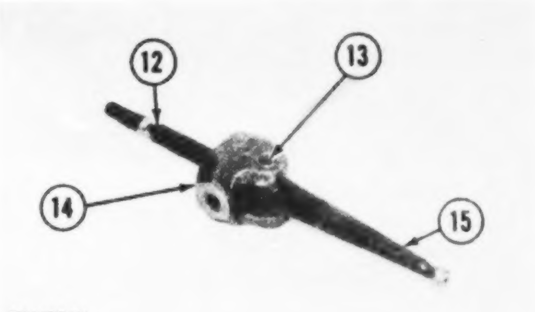
3. Remove the boot (1) from the lever assembly.



81505X1

4. Remove bolts (11) and the interlock mechanism (6).

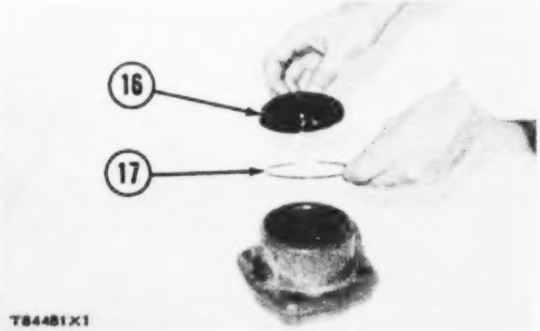
5. Remove nuts (10) and the lever assembly (7).



TB4482X1

6. Remove screws (9) and locks. Remove the lever assembly from the adapter (8).

7. Remove the pin (13). Remove the levers (12) and (15) from the block (14).

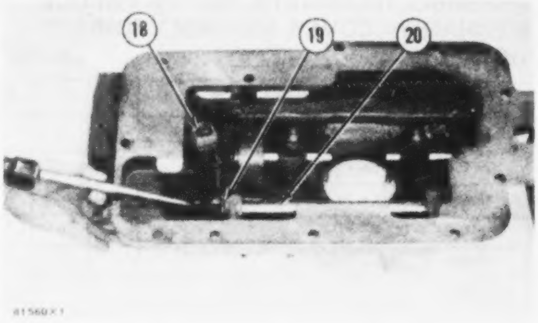


TB4481X1

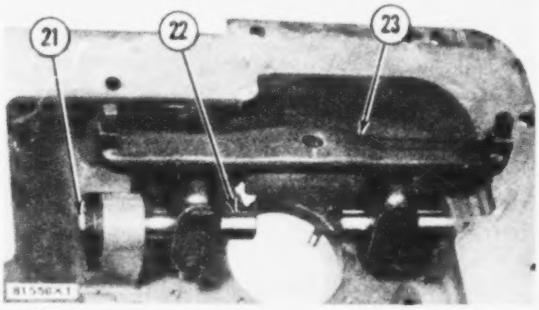
8. Remove the snap ring (17) and boot (16) from the adapter.

GEARSHIFT & INTERLOCK MECHANISM COVER ASSEMBLY (DIRECT DRIVE)

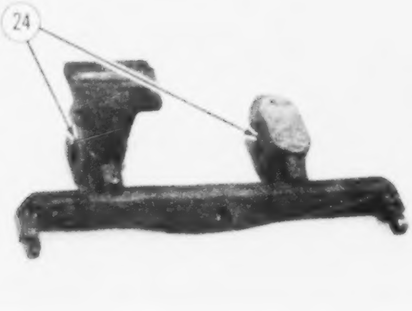
9. Loosen the bolt that holds the lever for forward and reverse to the shaft. Move the shaft with a hammer and punch until it is clear of the lever. Remove the lever (18). Remove the key from the shaft. Remove the washer (19) and shaft (20) from the cover assembly. Remove the two bearings for the forward and reverse shaft.



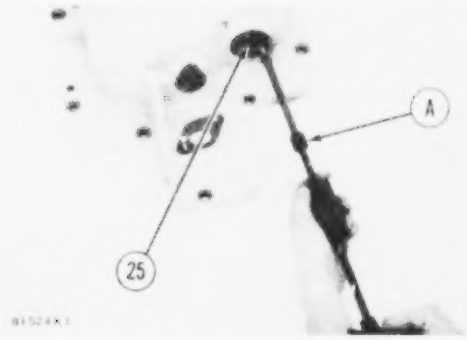
10. Remove the bolts (21) and shafts (22) from each end of the speed selector arm. Remove the speed selector arm (23).



11. Remove the two bearings (24) from the speed selector arm.



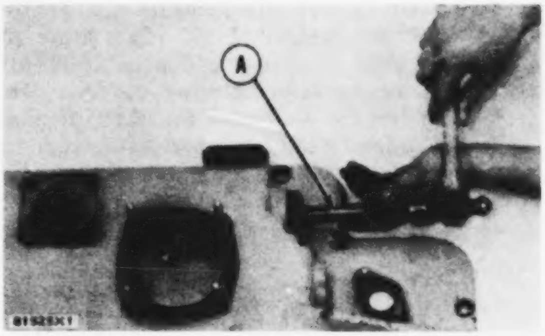
12. Remove the seal (25) for the forward and reverse shaft with tool group (A).



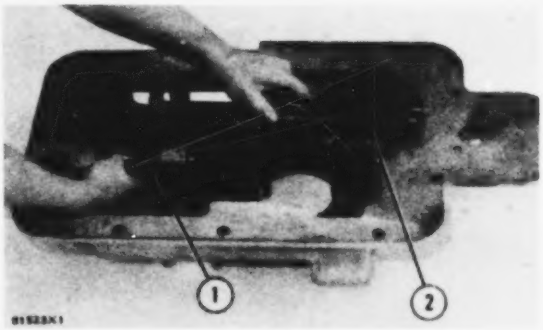
GEARSHIFT & INTERLOCK MECHANISM COVER ASSEMBLY (DIRECT DRIVE)

ASSEMBLE GEARSHIFT AND INTERLOCK MECHANISM COVER ASSEMBLY (DIRECT DRIVE) 16–3070

Tools Needed		A	B	C
1P529	Handle	1	1	1
1P463	Drive Plate	1		1
1P483	Drive Plate	1		
1P468	Drive Plate		1	
1P465	Drive Plate		1	
1P467	Drive Plate			1

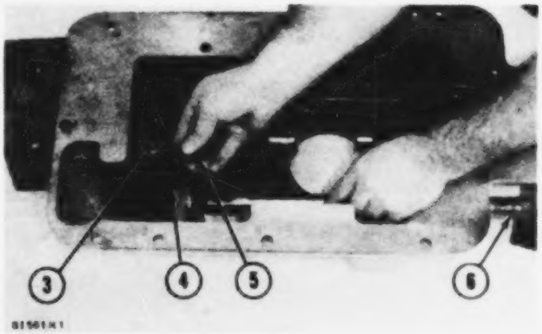


1. Install the seal for the forward and reverse shaft in the cover assembly with tooling (A).



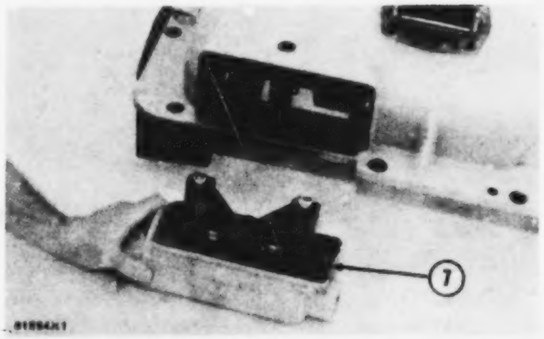
2. Install the two bearings in the speed selector arm with tooling (B).

3. Put the speed selector arm (2) in position in the cover assembly. Install the two shafts (1) and the bolts that hold them.



4. Install the two bearings for the forward and reverse shaft in the cover assembly with tooling (C).

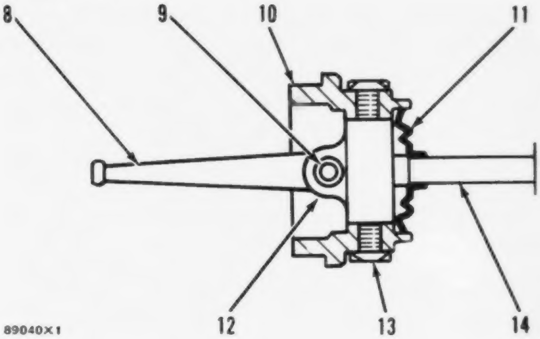
5. Install the shaft (6) for forward and reverse in the cover assembly until the groove for the key is past the second bearing. Install the washer (4) and key (5) on the shaft. Put the groove in the lever (3) in alignment with the key. Move the shaft through the lever. Tighten the bolt that holds the lever on the shaft.



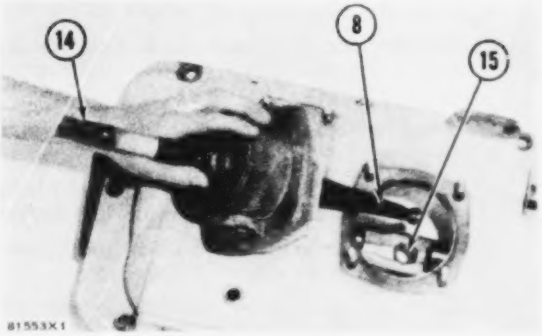
6. Put the interlock mechanism (7) in position on the cover assembly. Install the bolts that hold it.

GEARSHIFT & INTERLOCK MECHANISM COVER ASSEMBLY (DIRECT DRIVE)

7. Put the bores of levers (8) and (14) in alignment with the bore of the block (12). Install the pin (9) that holds the levers and the block together. Install the boot (11) and snap ring in the adapter (10). Put the lever assembly in position in the adapter. Install screws (13) and locks that hold them.

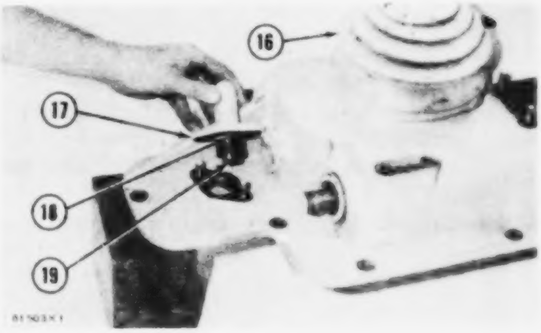


8. Install the lever assembly on the cover assembly by engaging the lower lever (8) in the hole (15) in the speed selector arm. Install the nuts that hold the lever assembly to the cover assembly.



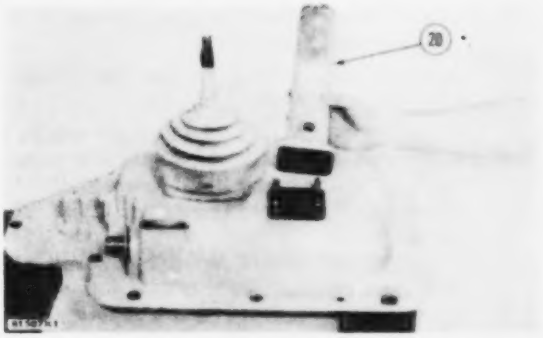
NOTE: Make sure the key in the top lever (14) is oward the right side of the cover assembly.

9. Install the rubber boot (16) over the lever assembly.



10. Put the spring and plunger (19) in the plunger housing. Install the pin (18) that holds the plunger in the housing. Install the plunger assembly (17) and nuts that hold it.

11. Install the oil filler spout (20) and nuts that hold it.



end by:
   a) install gearshift and interlock mechanism cover assembly

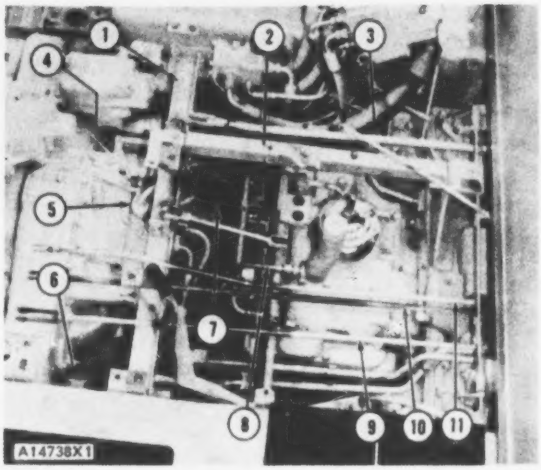
FLYWHEEL CLUTCH (DIRECT DRIVE)

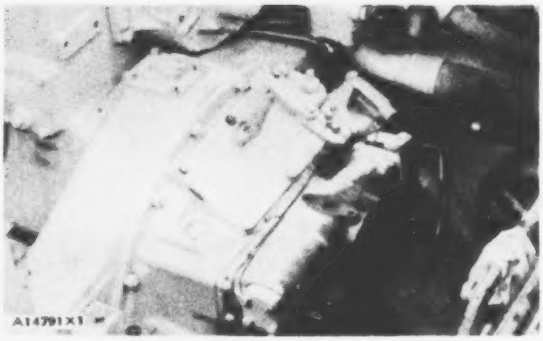
REMOVE FLYWHEEL CLUTCH (DIRECT DRIVE) 11–3052

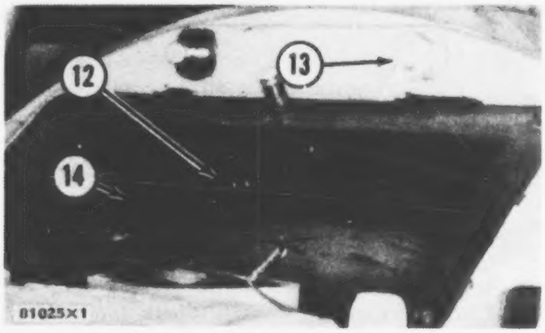
	Tools Needed	A
8B7554	Bearing Cup Pulling Attachment	1
5F7345	Screw	1
8B7560	Step Plate	1

start by:
- a) remove seat and seat frame assembly
- b) remove universal joint
- c) remove brake pedals and dash
- d) remove crankcase guard (rear)

1. Drain the oil from the flywheel clutch.
2. Remove the side panel from over the hydraulic control valves for the bulldozer (if so equipped).
3. Remove crossmember (1) and seat frame support (2).
4. Remove four rods (9), (10), (11) and (3) for the steering clutch controls and the brakes.
5. Remove four oil lines (5) from the hydraulic control mechanism.
6. Remove vent line (8). Disconnect vent line (7) to the transmission.
7. Disconnect bracket (6) for the oil cooler lines.
8. Disconnect two grease lines (4) from the flywheel clutch.
9. Put the flywheel clutch in position so it is not engaged. Keep it in position by a wire around the bellcrank and the hydraulic control mechanism.
10. Remove inspection cover, spring and lever as a unit from the flywheel clutch. Remove the access cover from the flywheel housing.
11. Remove bolts (12). Turn the flywheel to remove all of the bolts. Install three 3/8"–16 NC forged eyebolts in the flywheel clutch cover. Fasten a hoist to the flywheel clutch.
12. Remove nuts (13) that hold the flywheel clutch to the flywheel housing.
13. Install three 1/2"–13 NC forcing screws in the flywheel clutch cover. Make a separation of the flywheel clutch from the flywheel housing approximately 1.00 in. (25.4 mm). Make a separation of bracket (14) from the flywheel with a 1/2"–13 NC forcing screw.

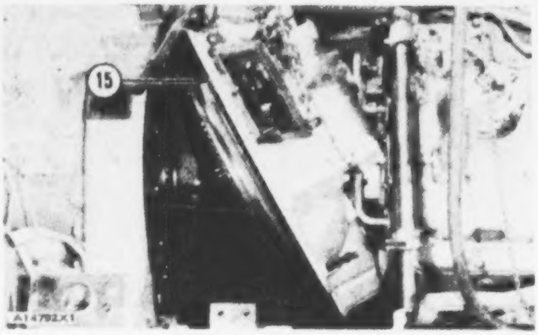


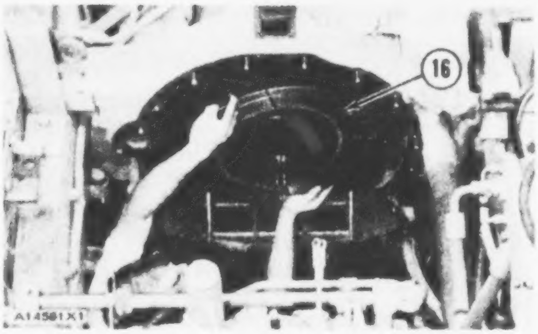




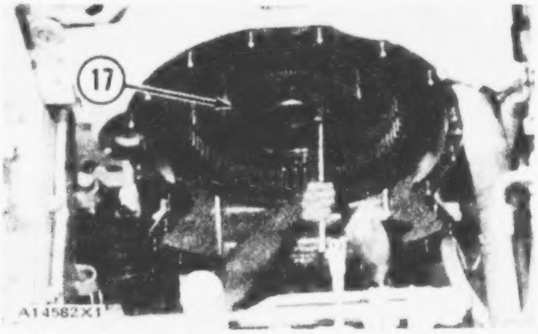
FLYWHEEL CLUTCH (DIRECT DRIVE)

14. Move the flywheel clutch to the rear enough to install a wire around the clutch components. This will prevent the components from falling off of the output shaft when the flywheel clutch is removed. Remove the flywheel clutch (15). Weight of the flywheel clutch is 550 lb. (249 kg).

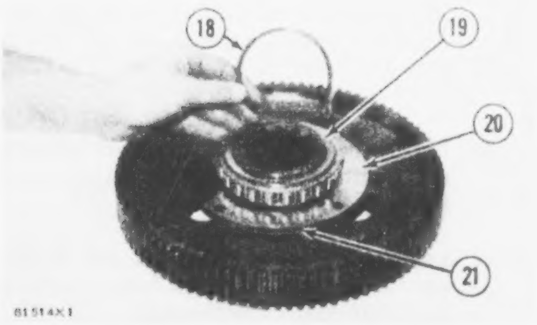




15. Remove the three discs (16) and two plates from the flywheel.



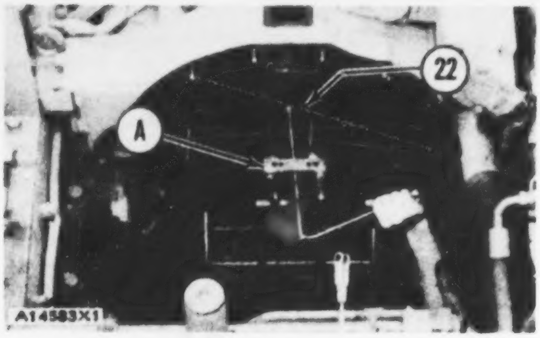
16. Remove bolts and the hub (17) from the flywheel.



17. Remove the snap ring (18) from the hub. Put hot oil over the bearing roller (19) and remove it from the hub. Remove the ring (20) and lock (21) from the hub.

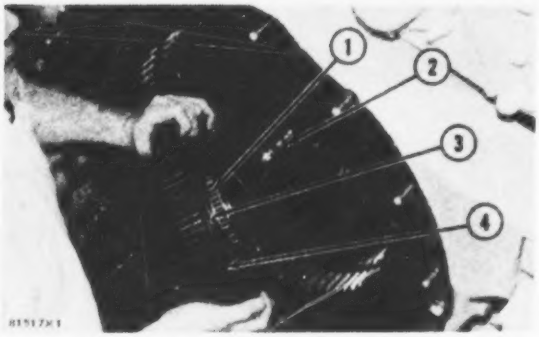
FLYWHEEL CLUTCH (DIRECT DRIVE)

18. Remove bearing race (22) with tooling (A).



INSTALL FLYWHEEL CLUTCH (DIRECT DRIVE) 12–3052

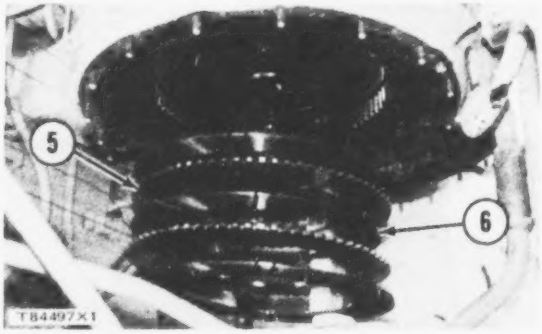
1. Install the lock and ring (3) on the hub (4). Heat the bearing roller (1) in oil to a maximum temperature of 275°F (135°C) and install it on the hub. Install the snap ring that holds the bearing roller on the hub.



2. Lower the temperature of the bearing race (2) and install it in the flywheel. Make sure the shoulder end of the race is toward the bottom of the bore in the flywheel.

3. Put the hub in position on the flywheel and install the bolts that hold it.

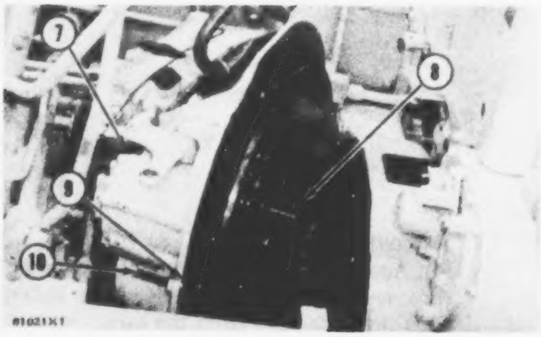
4. Install the three discs (6) and two plates (5) in the order shown.



5. Fasten a hoist to the flywheel clutch (7) and put it in position on the flywheel housing. Put the splines (8) of the output shaft in alignment with the splines of the hub. Remove the wire (9) and forcing screws (10). Install the flywheel clutch. Install nuts and bolts. Tighten the 1/2"–13 NC nuts and bolts to a torque of 85 ± 5 lb.ft. (11.8 ± 0.7 mkg). Tighten the 3/8"–16 NC nuts and bolts to a torque of 32 ± 5 lb.ft. (4.4 ± 0.7 mkg).

6. Put the holes in the clutch bracket in alignment with the holes in the flywheel. Install the bolts that hold it.

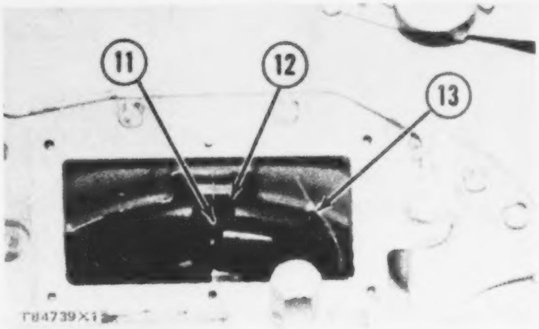
7. Install the control rod for the flywheel clutch. Remove the wire from around the hydraulic control mechanism.

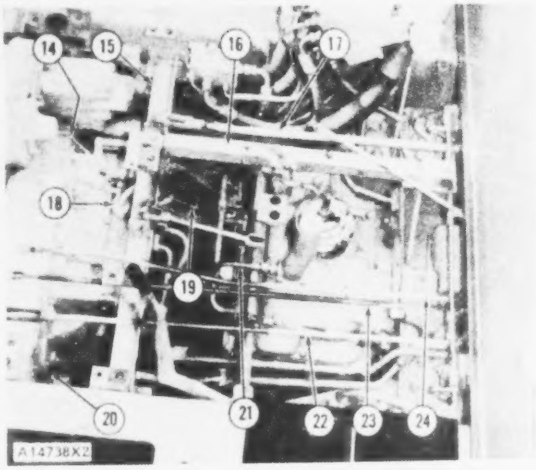


TYPICAL EXAMPLE

FLYWHEEL CLUTCH (DIRECT DRIVE)

8. Make an adjustment to the flywheel clutch (with engine not running) as follows:
   a) Fasten a spring scale at the bottom of the handle for the clutch control lever. Check the pounds of force needed to engage the clutch to make sure it is 175 ± 5 lb. (79.4 ± 2.3 kg).
   b) If an adjustment is needed, loosen nut (11) about two turns. Make sure plate (12) is free on its stud. Turn the flywheel 180° and loosen the other nut and plate using the same procedure.
   c) Turn the adjusting ring (13) clockwise to increase or counterclockwise to decrease the pounds of force.





9. Install the access cover over the flywheel on the flywheel housing.

10. Install the inspection cover, lever and spring on the cover of the flywheel clutch.

11. Connect the two grease lines (14) to the flywheel clutch.

12. Connect bracket (20) to the cover of the flywheel clutch.

13. Install vent line (21). Connect vent line (19) for the transmission.

14. Connect the four oil lines (18) to the hydraulic control mechanism.

15. Install four rods (22), (23), (24) and (17) for the steering clutch controls and the brakes.

16. Install crossmember (15) and seat frame support (16).

17. Install the side panel over the hydraulic control valves for the bulldozer (if so equipped).

18. Fill the flywheel clutch with oil to the correct level. See LUBRICATION AND MAINTENANCE GUIDE.

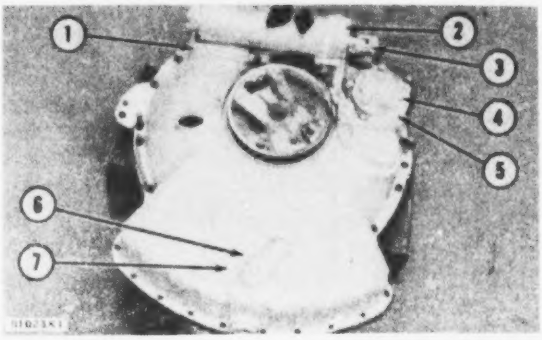
    end by:
    a) install crankcase guard (rear)
    b) install brake pedals and dash
    c) install universal joint
    d) install seat and seat frame assembly

FLYWHEEL CLUTCH (DIRECT DRIVE)

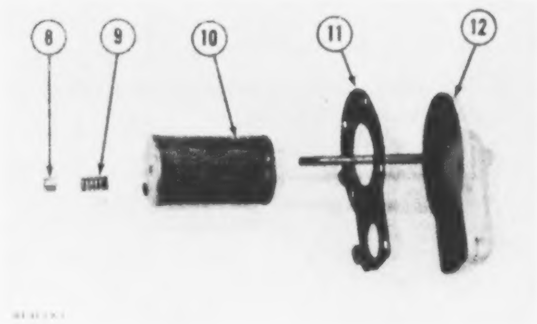
DISASSEMBLE FLYWHEEL CLUTCH (DIRECT DRIVE 15–3052

Tools Needed		A	B	C
1P3527	Compressor	1		
8B7548	Puller Assembly		1	
8B7554	Bearing Cup Pulling Attachment		1	
8H684	Ratchet Box Wrench		1	
1P3075	Puller Group			1

start by:
a) remove flywheel clutch



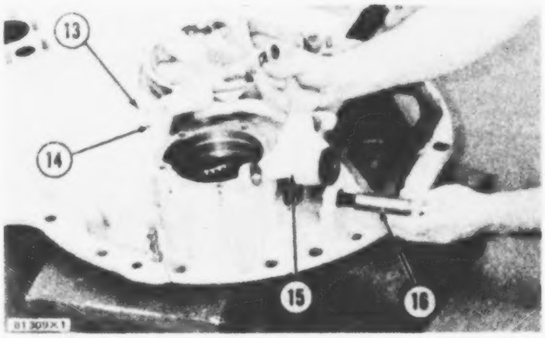
1. Remove the bolts and nuts (1) that hold the hydraulic control mechanism to the clutch cover. Disconnect the links (3) of the mechanism from the bellcrank lever. Remove the mechanism (2) from the clutch cover.



2. Remove bolts (5) and the oil pump (4).

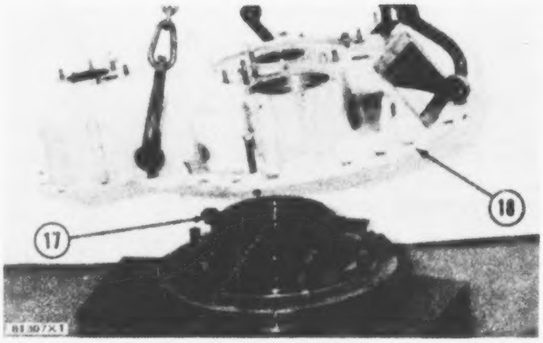
3. Remove nuts (6) and the oil screen and cover as a unit (7).

4. Remove the nut (8), spring (9), screen (10), and gasket (11) from the cover (12).



5. Remove bolt (16) and bellcrank lever (15).

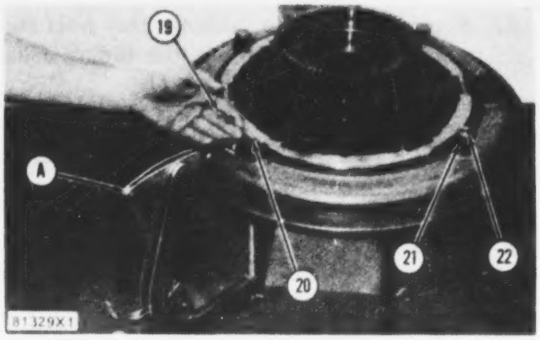
6. Remove nuts (13) and brake lever (14).



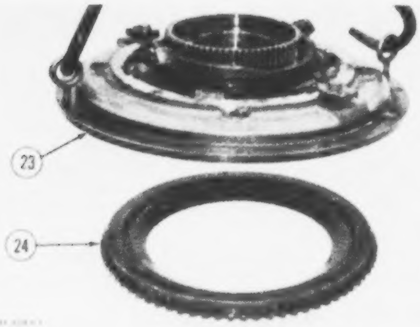
7. Fasten a hoist to the clutch cover (18) and remove it. Make sure the blocks (17) move out of the actuating yokes in the clutch cover. Weight of the clutch cover is 125 lb. (57 kg).

FLYWHEEL CLUTCH (DIRECT DRIVE)

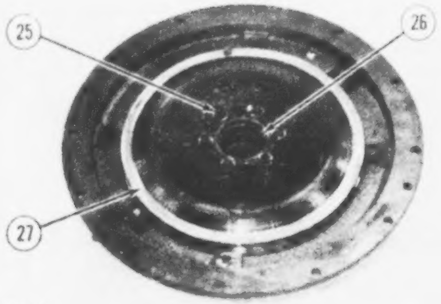
8. Remove the locks (19), retainers (22), springs (21), and pins (20) from the pressure plate with tool (A).



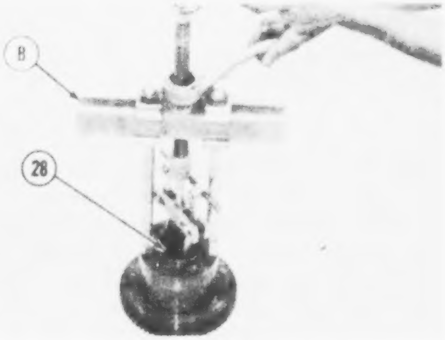
9. Fasten a hoist to the bracket for the adjustment ring. Remove the bracket (23) from the pressure plate (24).



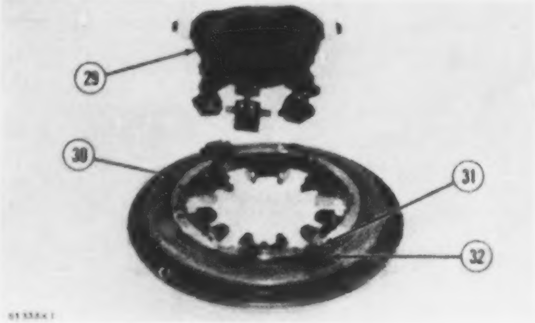
10. Turn the bracket for the adjustment ring over. Remove the bolts (25) and locks that hold the loading plate and hub to the bracket. Fasten a hoist to the bracket. Remove the loading plate (27) and bracket from the hub (26).



11. Remove the two bearings (28) from the hub with tooling (B).

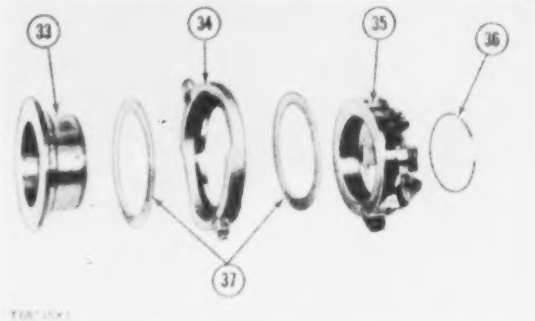


FLYWHEEL CLUTCH (DIRECT DRIVE)



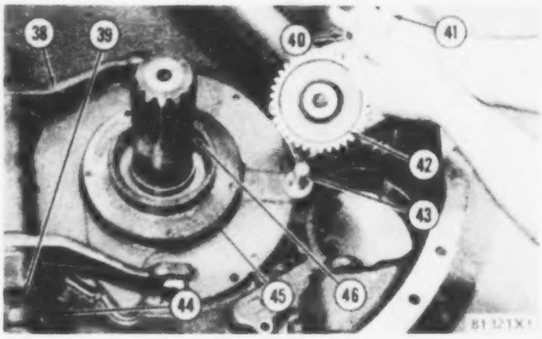
12. Remove the twelve bushings that hold the adjustment plate (30) to the sliding collar (29). Remove the sliding collar.

13. Remove the nuts (31), locks (32), and plates from the bracket. Remove the adjustment plate from the bracket by turning it counterclockwise.



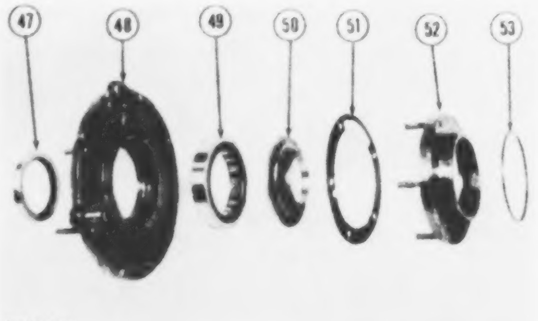
14. Disassemble the sliding collar by removing the snap ring (36), collar assembly (35), washers (37) and collar (34) from the sleeve (33).

15. Remove the snap ring (40), idler gear (42) for the oil pump, and washers (41) from its shaft (43).



16. Loosen bolt (44). Remove the shaft, lever (39), and actuating yokes (38) from the clutch cover with a hammer and punch. Remove the bearings for the shaft.

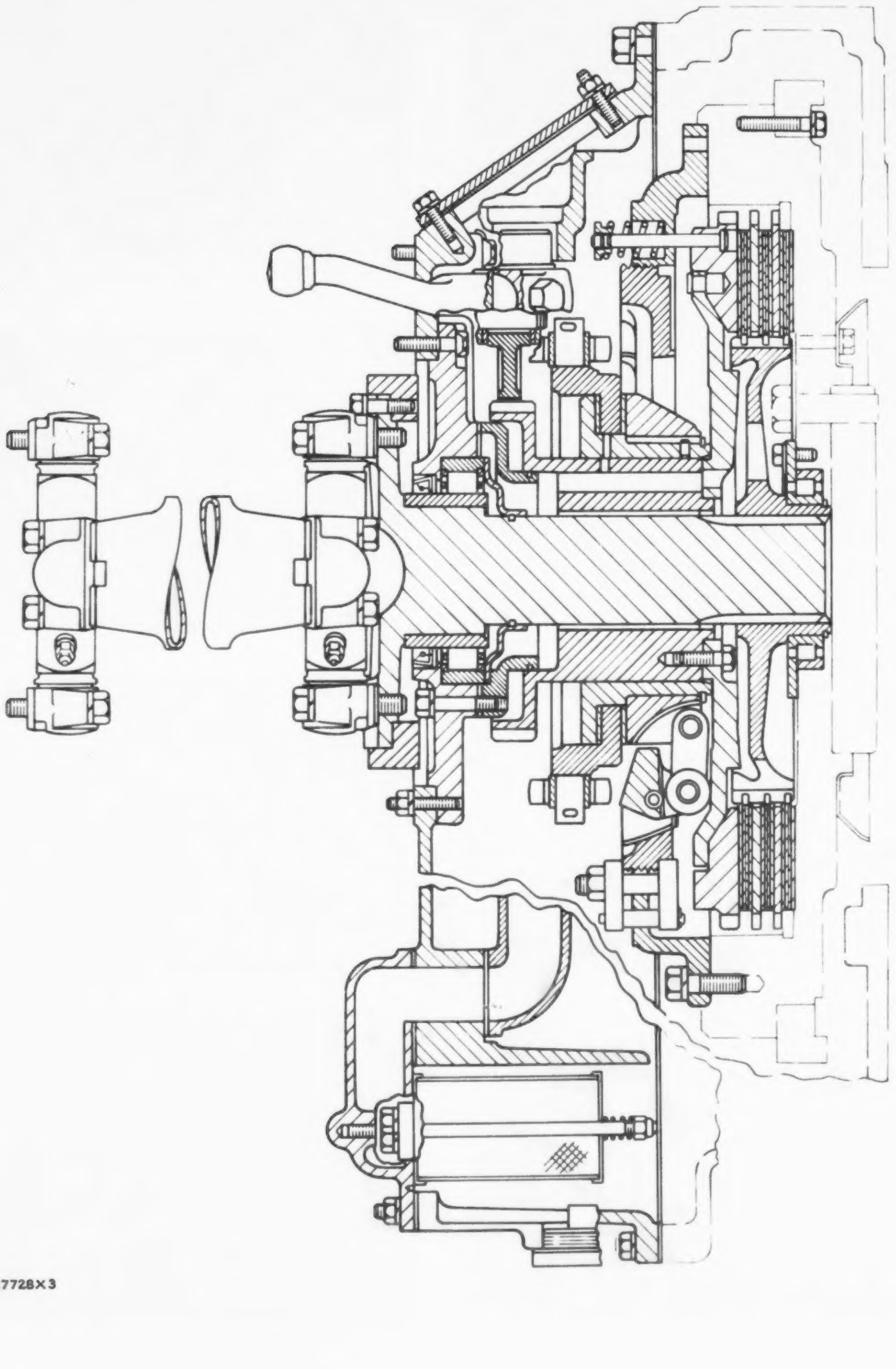
17. Remove the output shaft (46).



18. Remove the nuts that hold the bearing cage (45) to the clutch cover. Remove the bearing cage.

19. Remove the snap ring (53). Remove the nuts that hold the retainer assembly (52) to the bearing cage. Remove the retainer assembly, gasket (51), and retainer (50). Remove the seal (47) from the bearing cage with tool group (C). Remove the bearing (49) from the bearing cage.

FLYWHEEL CLUTCH (DIRECT DRIVE)



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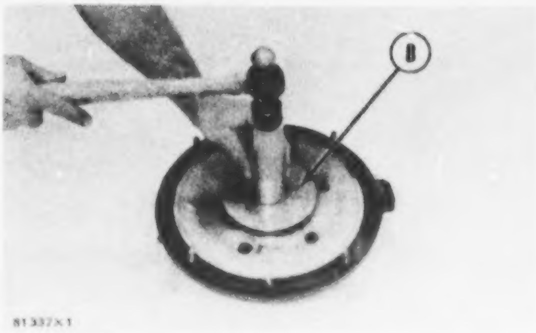
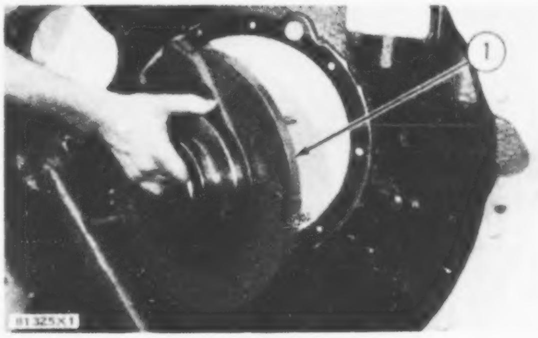
FLYWHEEL CLUTCH (DIRECT DRIVE)

ASSEMBLE FLYWHEEL CLUTCH (DIRECT DRIVE) 16–3052

Tools Needed		A	B	C	D	E	F
1P532	Handle	1	1				
1P525	Drive Plate	1	1				
1P513	Drive Plate	1					
1P514	Drive Plate		1				
1P529	Handle			1	1		
1P477	Drive Plate			1	1		
1P468	Drive Plate			1			
1P464	Drive Plate				1		
8B7548	Puller Assembly					1	
8B7554	Bearing Cup Pulling Attachment					1	
8H684	Ratchet Box Wrench					1	
1P3527	Compressor						1

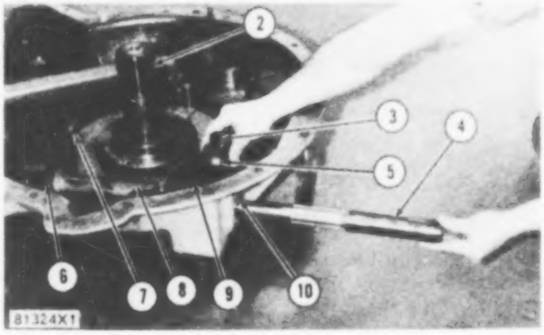


1. Install the bearing in the bearing cage with tooling (A). Install the seal in the bearing cage with tooling (B).



2. Install the retainer and gasket on the bearing cage. Put the retainer assembly on the bearing cage and install the nuts that hold it. Install the snap ring on the retainer assembly. Put the bearing cage (1) in position on the clutch cover and install the nuts that hold it.

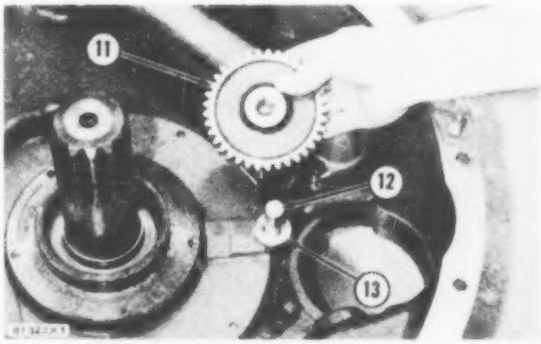
3. Install the output shaft (2) in the clutch cover.



4. Install bearing (9) in the clutch cover with tooling (C). Install bearing (6) with tooling (D).

5. Put the actuating yokes (8) and lever (5) in position on the clutch cover. Install the shaft (4) through the lever and yokes. Tighten bolt (3). Install the cap plug in opening (10).

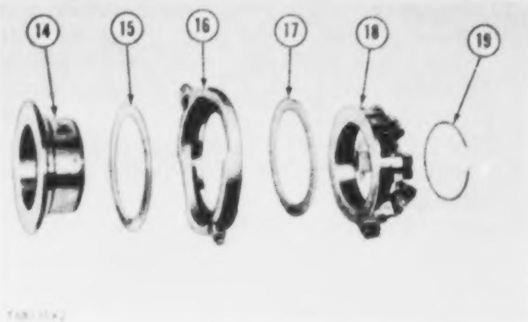
NOTE: The grooves (slots) (7) in the actuating yokes have slopes pointing down. Install the yokes so that the slopes in the grooves are toward the bearing cage.



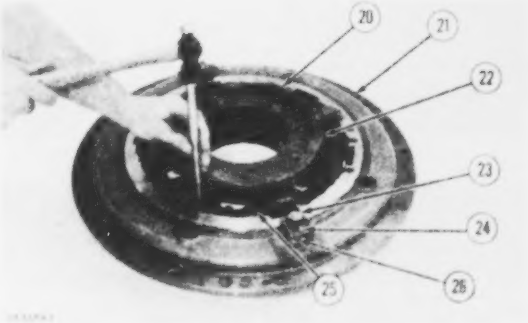
6. Install one washer (13) on the shaft (12). Install the idler gear (11) for the oil pump on the shaft. Install two washers and a snap ring that hold the gear on the shaft.

FLYWHEEL CLUTCH (DIRECT DRIVE)

7. Install the washer (15), collar (16), washer (17), and collar assembly (18) on the sleeve (14). Install the snap ring (19) on the sleeve.

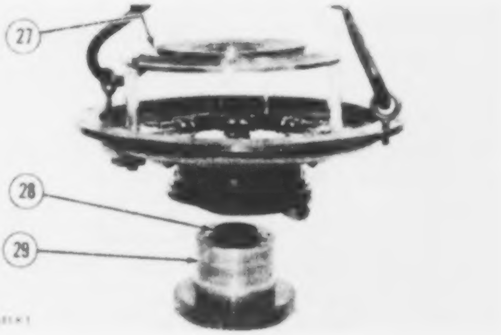


8. Install the adjustment plate (20) into the bracket (21) by turning it clockwise. Install the locks (24), plates (26), and nuts (23) in the bracket.

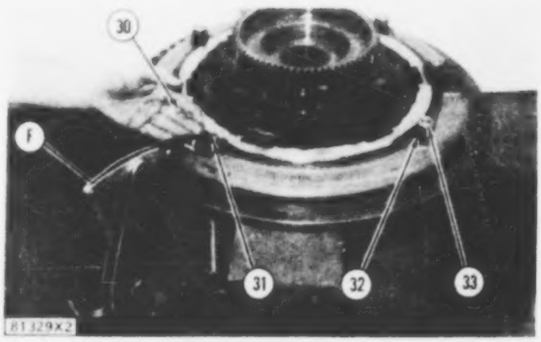


9. Install the sliding collar assembly (22) on the bracket. Install the twelve bushings (25) in the sliding collar assembly. Install the bushings in the adjustment plate with a hammer and punch.

10. Install two bearings in the hub with tooling (E). Install the lower bearing even with the bottom of the bearing bore. Install the top bearing (28) .38 in. (9.7 mm) from the top of the hub.



11. Install the hub in the collar assembly. Put the loading plate (27) in position on the hub. Install the bolts and locks that hold the loading plate, collar assembly, and hub together.



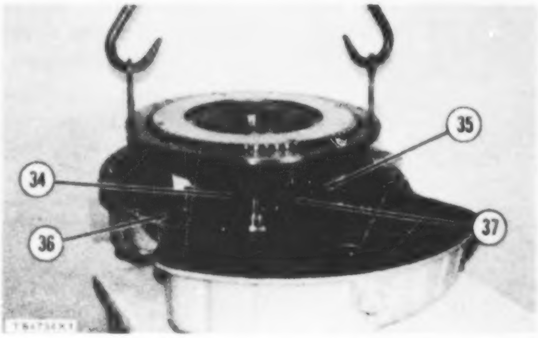
81329X2

12. Put the collar assembly, loading plate, and hub as a unit on the pressure plate. Install the pins (31), springs (32), retainers (33), and locks (30) with tool (F).

FLYWHEEL CLUTCH (DIRECT DRIVE)

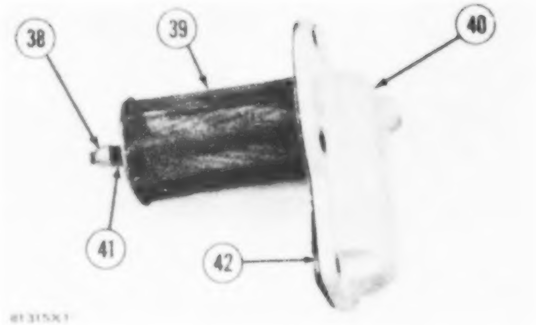
13. Install two 1/2"–13NC forged eyebolts and fasten a hoist to the unit. Install the unit over the output shaft. Make sure the blocks (37) are in the grooves (slots) in the yokes (35) when lowering the unit. Make sure the teeth of the idler gear (36) for the oil pump are in alignment with the teeth of its drive gear (34).

14. Install a wire around the inner clutch components. Turn the clutch over.



15. Put the gasket (42), screen (39) and spring (41), over the stud in the cover (40). Install nut (38).

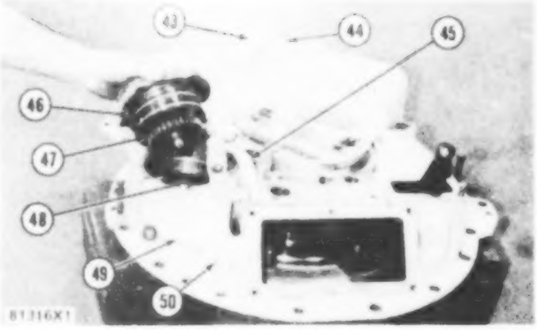
16. Install the screen and cover as a unit (43) on the clutch cover and install bolts (44) that hold it.



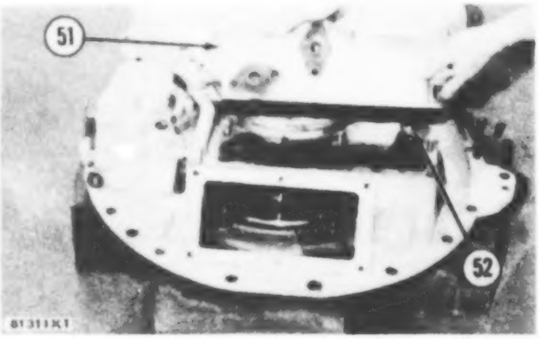
17. Install the lever (45) for the clutch brake and the nuts that hold it.

18. Install the bellcrank lever (49) and the bolt (50) that holds it.

19. Put the teeth of the gear (47) for the oil pump in alignment with the teeth of its idler gear (48). Install the oil pump (46) and the bolts that hold it.



20. Put the hydraulic control mechanism (51) in position on the clutch cover. Make sure the end of lever (52) engages in the coupling in the mechanism. Install the nuts and bolts that hold it. Connect the links on the mechanism to the bellcrank lever.



end by:
   a) install flywheel clutch

TRANSMISSION (DIRECT DRIVE)

REMOVE TRANSMISSION (DIRECT DRIVE) 11–3060

start by:
- a) remove crankcase guard (rear)
- b) remove seat and seat frame assembly
- c) remove universal joint

NOTE: The dash is removed for better photo illustration.

1. Remove the side panel from over the bulldozer hydraulic control valves (if so equipped).

2. Drain the oil from the transmission and bevel gear case.

3. Remove the directional selector lever.

4. Remove rods (4), (5), (6) and (1) for the steering clutch controls and the brakes.

5. Move rod (2) out of the way of the transmission.

6. Remove rod (3) for the flywheel clutch controls.

7. Remove seat frame support (8) and crossmember (7). Remove clutch linkage (11) and rod (12) for the interlock mechanism. Remove rod (2) for the parking brake. Remove oil line (13).

8. Disconnect oil line (19) from the relief valve for transmission lubrication. Remove oil line (9).

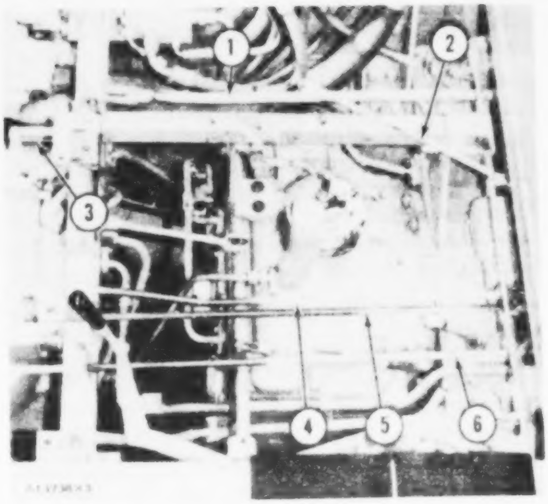
9. Remove oil line (14) from the side of the transmission.

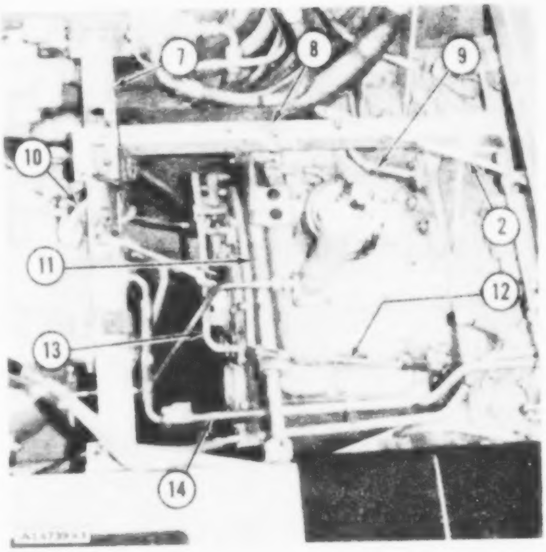
NOTE: Move all of the other oil lines out of the way of the transmission.

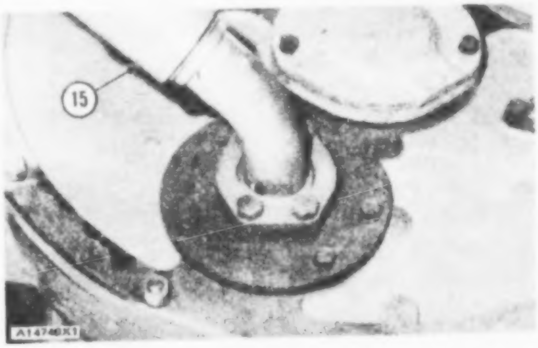
10. Remove oil supply line (15) from the bottom of the transmission.

11. Remove two bolts from the transmission cover. Install two 1/2"–13 NC forged eyebolts in the holes. Fasten a hoist to the transmission.

12. Remove the nuts that hold the transmission to the bevel gear case. Move the transmission forward until the input and bevel pinion shafts are clear of the bevel gear case. Remove the transmission. Weight of the transmission is 1500 lb. (680 kg).



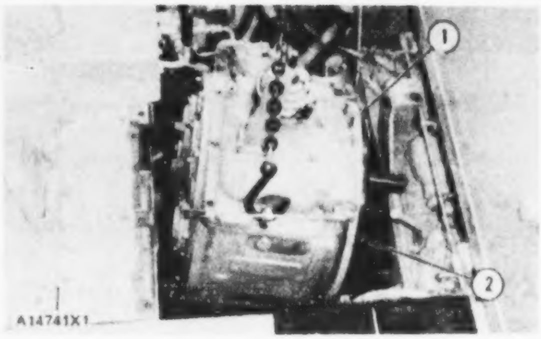




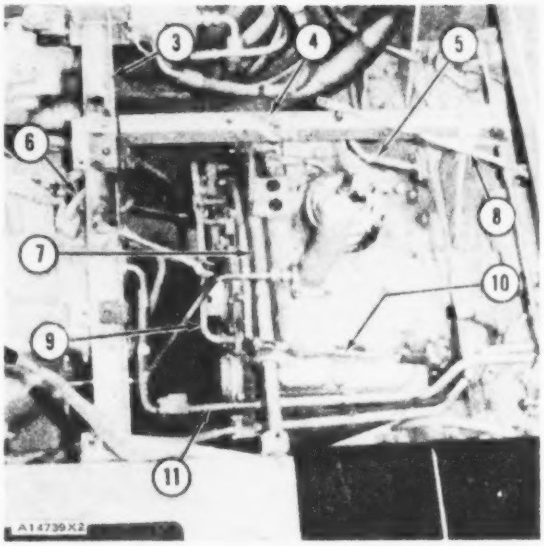
TRANSMISSION (DIRECT DRIVE)

INSTALL TRANSMISSION (DIRECT DRIVE) 12–3060

1. Fasten a hoist to the transmission (1). Put the transmission in position in the bevel gear case. Move the transmission to the rear and engage splines (2) of the input shaft and bevel pinion shaft with the splines in the bevel gear case. Install the nuts that hold the transmission to the bevel gear case. Remove the hoist and eyebolts. Install the two bolts back in the cover of the transmission.

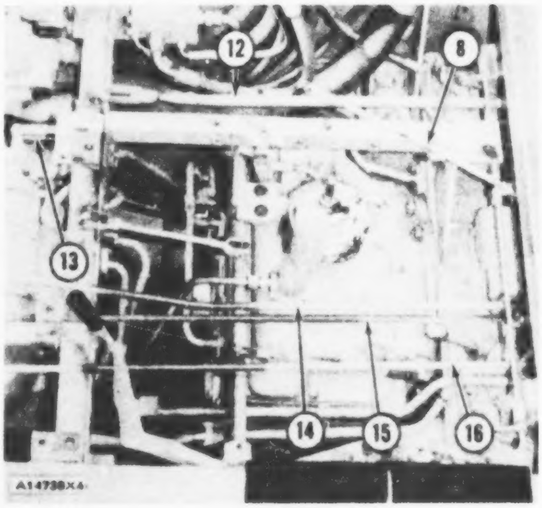


2. Connect the oil supply line to the bottom of the transmission.
3. Install oil line (11) on the side of the transmission. Install oil line (9).
4. Install oil line (5).
5. Install clutch linkage (7).
6. Install oil line (6) for the relief valve of the transmission.
7. Install crossmember (3) and seat frame support (4).
8. Connect rod (10) to the clutch linkage.
9. Install rod (8).



10. Install rod (13) for the flywheel clutch control.
11. Install rods (14), (15), (16) and (12) for the steering clutch controls and brakes.
12. Install the directional selector lever.
13. Install the side panel over the hydraulic control valves for the bulldozer (if so equipped).
14. Connect rod (8) to the parking brake lever.
15. Fill the transmission and bevel gear case with oil to the correct level with oil. See Lubrication and Maintenance Guide.

    end by:
    a) install universal joint
    b) install seat and seat frame assembly
    c) install crankcase guard (rear)

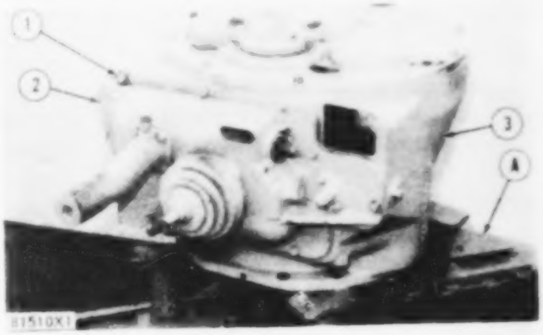


TRANSMISSION (DIRECT DRIVE)

DISASSEMBLE TRANSMISSION (DIRECT DRIVE) 15-3060

Tools Needed		A	B	C	D	E	F	G	H	J	K	L
1P2420	Repair Stand	1										
FT530	Puller Tool		1									
1P468	Drive Plate		1									
1P532	Handle			1	1			1				
1P523	Drive Plate			1				1				
1P515	Drive Plate			1								
1P513	Drive Plate				1							
1P490	Drive Plate				1							
1H3110	Bearing Pulling Attachment					1				1		
1H3107	Puller Assembly					1			1	1		1
1H3109	Leg					2				2		
7F9540	Hydraulic Puller					1						
8B7560	Step Plate					1			1			
9S5800	Pump Group					1						
8B7548	Puller Assembly						1				1	
8B7551	Bearing Pulling Attachment						1					
8H684	Ratchet Box Wrench						1					
8B7563	Extension						1					
1P498	Drive Plate							1				
5F7343	Bearing Pulling Attachment								1			
1H3108	Leg								2			
8F2239	Wrench								1	1		
8B7553	Adapter										1	
8B7554	Bearing Cup Pulling Attachment										1	
1H3112	Bearing Cup Pulling Attachment											1

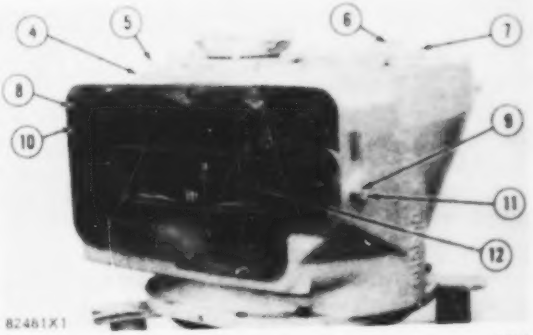
start by:
a) remove transmission (direct drive)



1. Install the direct drive transmission (3) on tool (A).

2. Fasten a hoist to the gearshift and interlock mechanism cover assembly (2). Remove the bolts (1). Remove the cover assembly.

3. Remove bolt (9) and shaft (11) from each end of the speed selector arm (12). Remove the arm.



4. Remove bolts (8) and the shift fork (10) for forward and reverse.

5. Remove bolts (7) and oil tube (6).

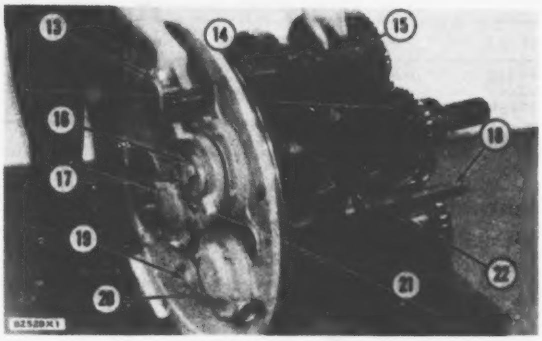
6. Remove the nuts (5). Install two 1/2"–13NC forcing screws in the cover. Lift the cover enough to install three 1/2"–13NC forged eyebolts and remove the cover (4), gears, and shafts as a unit. Weight is 950 lb. (431 kg).

TRANSMISSION (DIRECT DRIVE)

7. Remove shaft (13). Remove shift fork (15) for sixth speed. Remove shift fork (14) for fourth and fifth speeds.

8. Remove shaft (18). Remove shift fork (22) for third speed. Remove shift fork (21) for first and second speeds.

9. Remove two bolts (20) and shaft (19). Remove shift fork for forward and reverse.

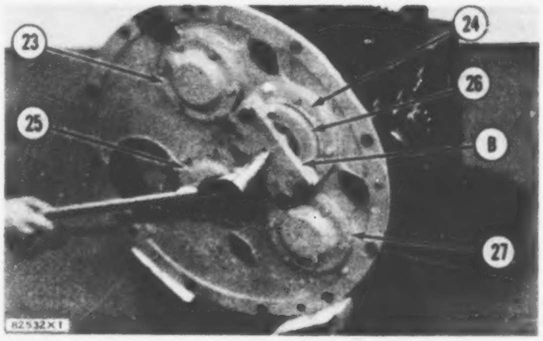


10. Remove the bushings and spacers from the shift forks.

11. Remove bolts (17), lock, and retainer (16).

12. Remove the input flange (26) with tooling (B).

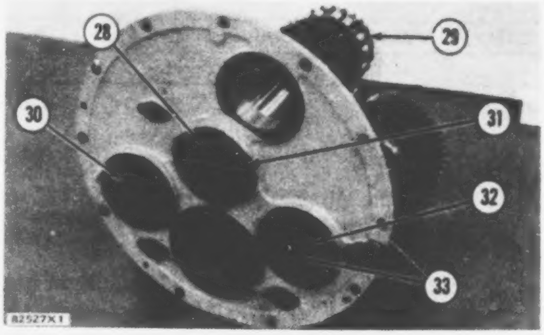
13. Remove the bolts and covers (23), (24), (25), and (27). Remove the seal from cover (25) with tooling (C).



14. Remove bolts (33) and locks. Remove washers (28), (30), and (32).

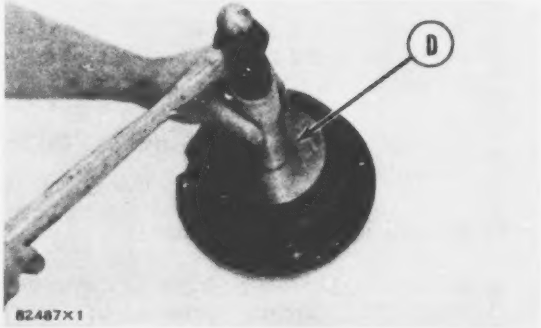
15. Fasten a hoist to the pinion shaft (29). Install three 1/2"–13NC forcing screws in bearing cage (31). Tighten the forcing screws evenly and remove the bearing cage and its shims. Remove the pinion shaft and its gears as a unit. Weight is 150 lb. (68 kg).

NOTE: Keep the shims with their bearing cage. The shims are necessary for adjustment to the pinion shaft at assembly.



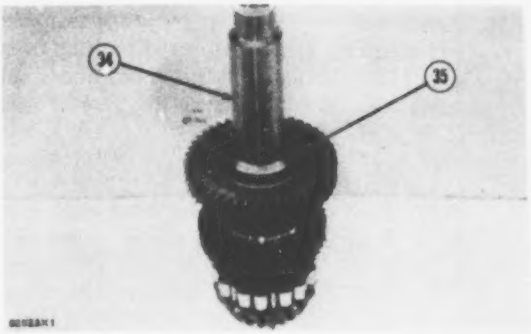
16. Remove the bearing assembly from the bearing cage for the pinion shaft with tooling (D).

NOTE: Put identification on all bearing assemblies. Keep the assemblies with their respective bearing cages. The bearing cups, cones, and a spacer are sold only as an assembly and cannot be mixed.

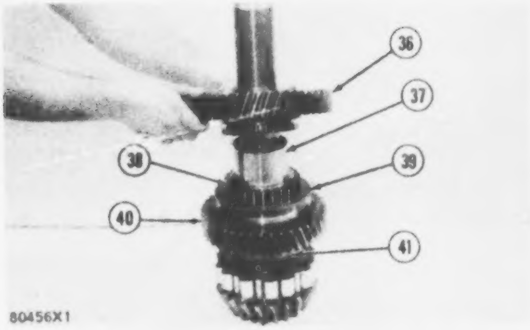


TRANSMISSION (DIRECT DRIVE)

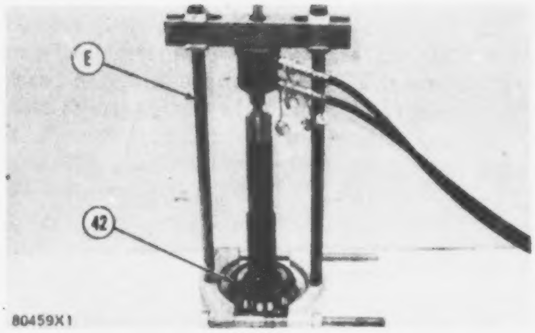
17. Remove sleeve (34) and spacer (35). Remove the pin from under the sleeve and spacer.



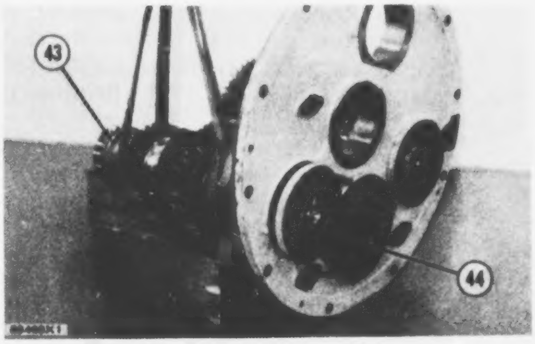
18. Remove gear (36), sleeve (37), gear (38), and collar (39). Remove the bushing from gear (36). Remove gear (40). Remove the bushing from gear (40). Remove the sleeve from under gear (40). Remove sleeve (41).



19. Remove the inner race and roller assembly (42) from the pinion shaft with tooling (E).

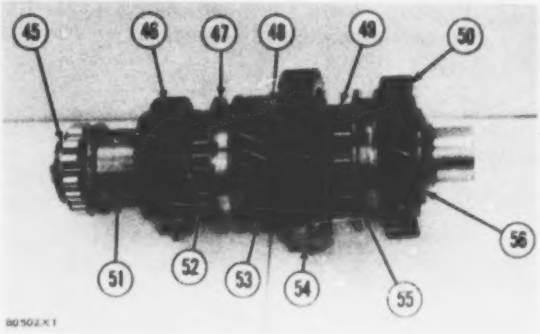


20. Fasten a hoist to the left shaft assembly and its gears (left countershaft). Install three 1/2"–13NC forcing screws in bearing cage (44). Tighten the forcing screws evenly and remove the bearing cage. Remove the bearing assembly from the bearing cage with tooling (D). Remove the left countershaft (43). Weight is 140 lb. (64 kg).

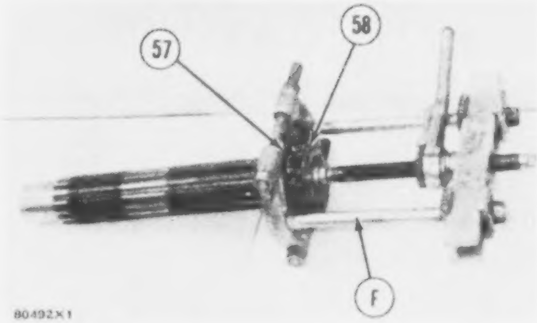


TRANSMISSION (DIRECT DRIVE)

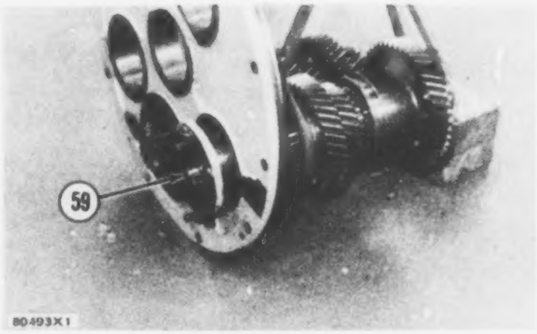
21. Remove spacer (56) and gear (50) from the left countershaft. Remove the bushing from gear (50). Remove the pin from under the spacer. Remove the sleeve from under gear (50). Remove collar (55), gear (49), and gear (54). Remove the bushing from gear (54). Remove the sleeve from under gear (54). Remove the spacer (48) and gear (53). Remove the sleeve from under gear (53). Remove collar (47), gear (52), gear (46), and sleeve (51). Remove the bolts, locks, and retainer (45).



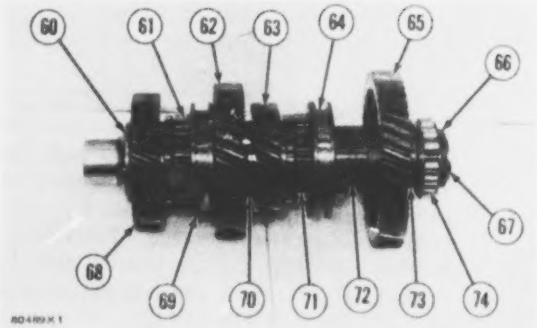
22. Remove the inner race and roller assembly (58) and spacer (57) from the shaft with tooling (F).



23. Fasten a hoist to the right shaft assembly and its gears (right countershaft). Install three 1/2"–13NC forcing screws in bearing cage (59). Tighten the forcing screws evenly and remove the bearing cage. Remove the bearing assembly from the bearing cage with tooling (D).

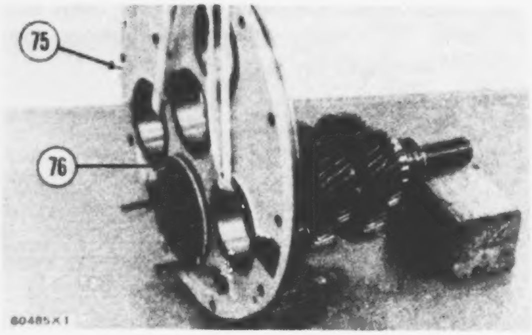


24. Remove spacer (60) from the right countershaft. Remove the pin from under the spacer. Remove gear (68). Remove the bushing from gear (68). Remove the sleeve from under gear (68). Remove collar (69), gear (61), and gear (62). Remove the bushing from gear (62). Remove the sleeve from under gear (62). Remove spacer (70) and gear (63). Remove the bushing from gear (63). Remove the sleeve from under gear (63). Remove the collar (64), gear (71), sleeve (72), and gear (65). Remove bolts (67), a lock, and retainer (66). Remove the inner race and roller assembly (74) and spacer (73) from the shaft with tooling (F).

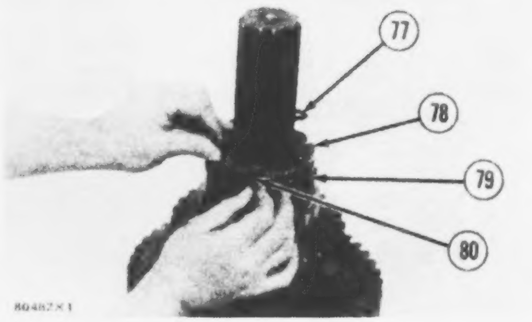


TRANSMISSION (DIRECT DRIVE)

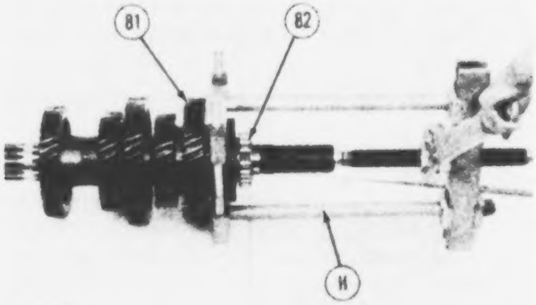
25. Fasten a hoist to the front cover (75). Put blocks under the input shaft and its gears (upper shaft). Install three 1/2"–13NC forcing screws in the bearing cage (76). Tighten the forcing screws evenly and remove the bearing cage. Remove the bearing assembly from the bearing cage with tooling (D). Remove the front cover. Weight of the front cover is 165 lb. (75 kg).

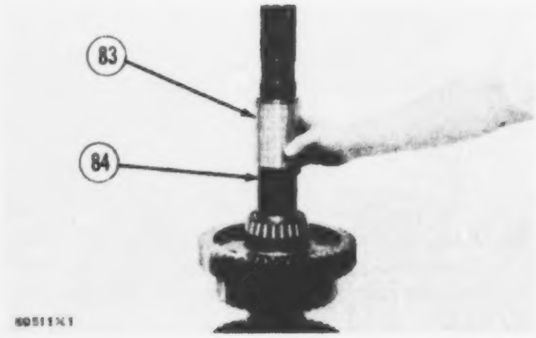


26. Remove ring (77) and pin (80) from nut (78). Remove the nut and spacer (79) from the upper shaft. Remove the key from under the spacer.



27. Remove the inner race and roller assembly (82) and idler cluster gear (81) with tooling (H). Remove the bearing cone from the top of the idler cluster gear. Remove the two bearing cups from the idler cluster gear.

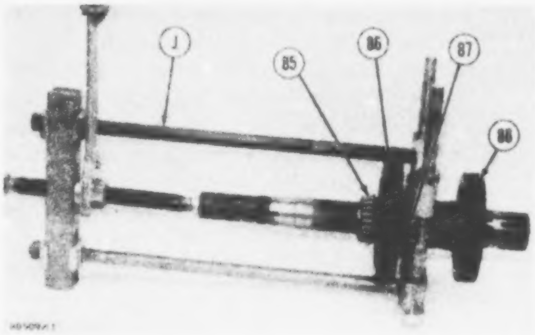




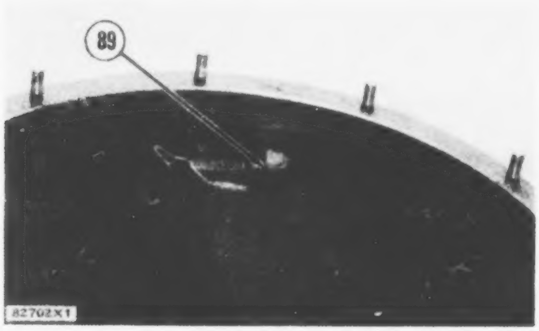
28. Remove sleeve (83) and shims (84) from the upper shaft.

TRANSMISSION (DIRECT DRIVE)

29. Remove bearing cone (85), gear (86), and gear (87) with tooling (J). Remove gear (88).

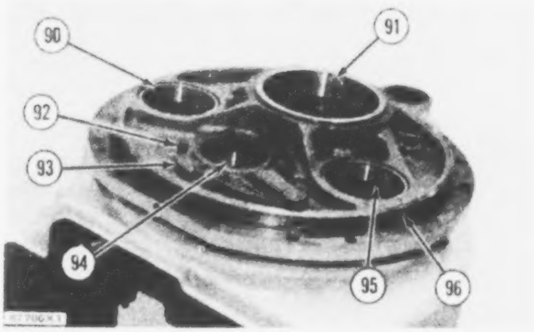


30. Remove bearing (89) for the forward and reverse shaft.

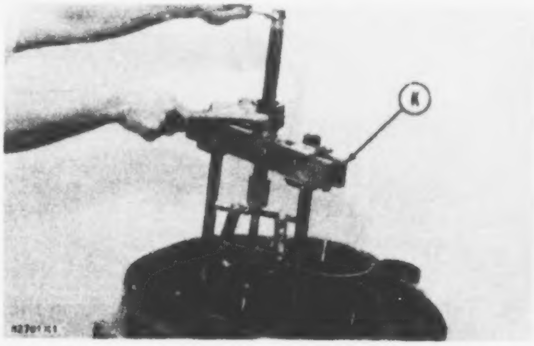


31. Turn the transmission case over on tool (A). Remove bolts (92) and oil manifold (93).

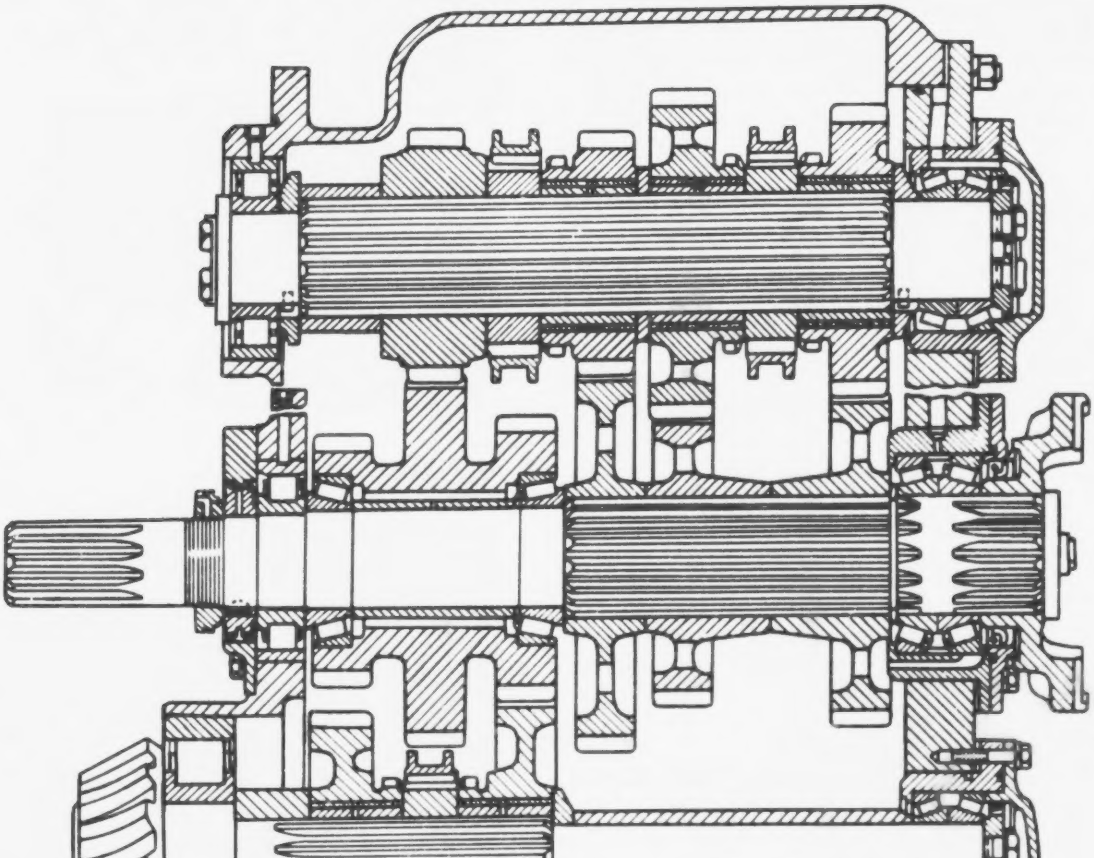
32. Remove cap plugs (96) and dowels that hold bearing races (91), (94), and (95) in position in the case. Remove set screw that holds bearing race (90) in position in the case.



33. Remove bearing races (90), (94), and (95) from the case with tooling (K). Remove bearing race (91) from the case with tooling (L).



TRANSMISSION (DIRECT DRIVE)



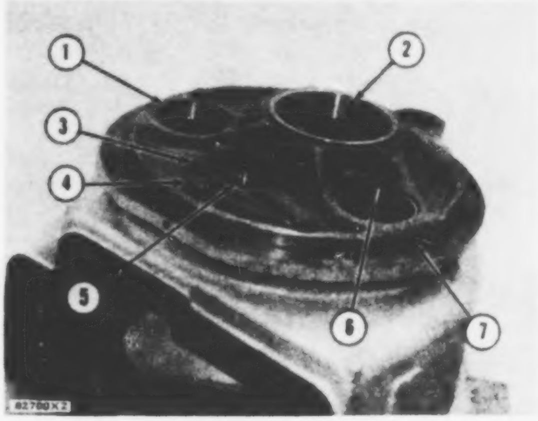
T84342X1

TRANSMISSION (DIRECT DRIVE)

ASSEMBLE TRANSMISSION (DIRECT DRIVE) 16–3060

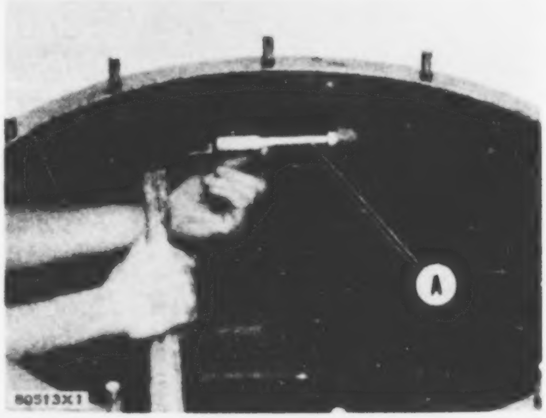
Tools Needed		A	B	C	D
1P529	Handle	1	1		
1P465	Drive Plate	1	1		
1P462	Drive Plate	1			
1P468	Drive Plate		1		
8S2328	Dial Test Indicator Group			1	
1S7691	Plate			2	
2B2391	Bolt			1	
1B4332	Nut			1	
1P532	Handle				1
1P524	Drive Plate				1
1P513	Drive Plate				1

1. Lower the temperature of bearing races (1), (2), (5), and (6). Put the races in their respective bores in the transmission case. Put the holes in the races in alignment with the dowel holes in the case. Install the dowels and cap plugs (7) that hold races (2), (5), and (6) in position in the case. Install the set screw that holds race (1) in position in the case.

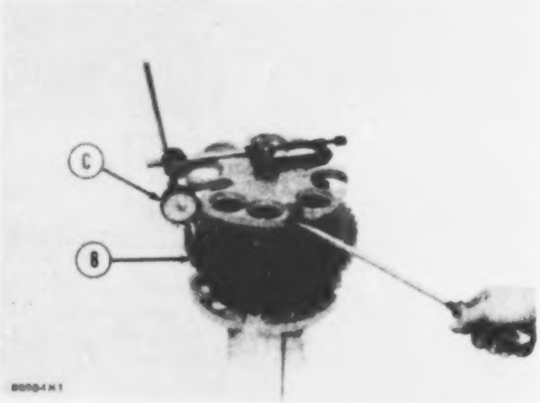


2. Install oil manifold (4) and bolts (3) that hold it.

3. Install the bearing for the forward and reverse shaft with tooling (A).



4. Lower the temperature of the two bearing cups for the idler cluster gear (8). Install the cups in the gear. Make sure the cups are against their seats in the gear. Check the preload of the bearings by installing the sleeve, bearing cones, and approximately .100 in. (2.54 mm) of shims into the bore of the idler cluster gear. Install tooling (C) on the gear. Check the bearing end clearance with the dial indicator and a screwdriver. Remove shims in the same amount as the measured end clearance plus .007 in. (0.18 mm).



TRANSMISSION (DIRECT DRIVE)

5. Install gears (21), (20), and (19) on input shaft (22).

6. Heat bearing cone (18) in oil to a maximum temperature of 275°F (135°C). Install the bearing cone on the input shaft.

7. Install the shims (17) which were measured in Step 4. Install sleeve (16).

8. Install idler cluster gear (8).

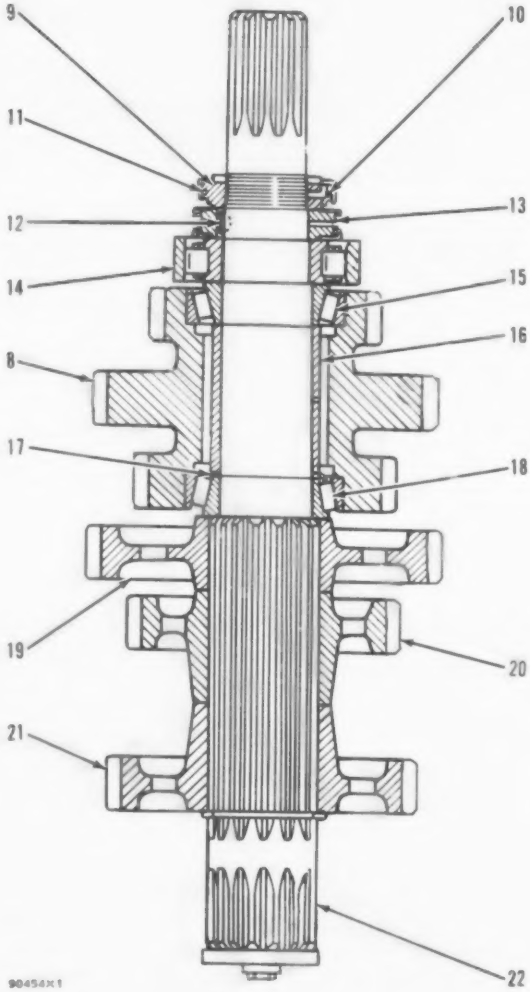
9. Heat bearing cone (15) and inner race and roller assembly (14) in oil to a maximum temperature of 275°F (135°C). Install the bearing cone on the input shaft. Make sure the bearing cone engages in its cup in the idler cluster gear. Install the inner race and roller assembly.

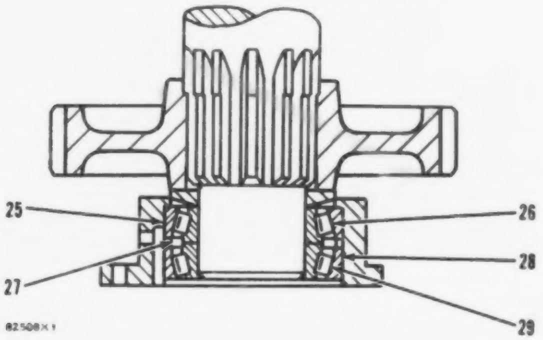
10. Install key (12) in the input shaft. Install spacer (13) over the key on the input shaft.

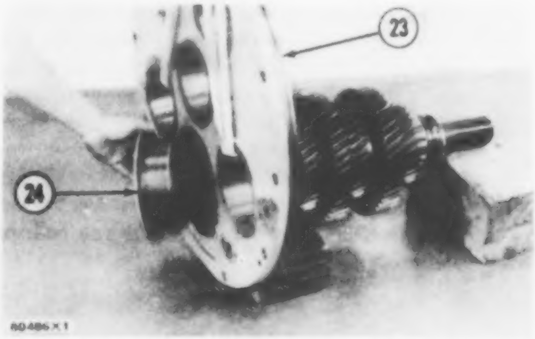
11. Install nut (9) on the input shaft. Put the hole in the nut in alignment with the hole in the input shaft. Install pin (10) in the holes. Install ring (11) that holds the pin in the nut.

12. Fasten a hoist to the input shaft and its gears (upper shaft) and put it on blocks. Fasten a hoist to the front cover (23). Put the bore in the cover in alignment with the end of the upper shaft. Install bearing cage (24) in the bore over the upper shaft.

13. Install bearing cup (25) and spacer (27) into the bearing cage. Heat bearing cones (26) and (29) in oil to a maximum temperature of 275°F (135°C). Install the bearing cones in the bearing cage. Install bearing cup (28).







TRANSMISSION (DIRECT DRIVE)

14. Put the groove in spacer (48) in alignment with pin (49) and install it on shaft (51).

15. Heat the inner race and roller assembly (50) in oil to a maximum temperature of 275°F (135°C) and install it on the shaft.

16. Install retainer (54), lock (52), and two bolts (53).

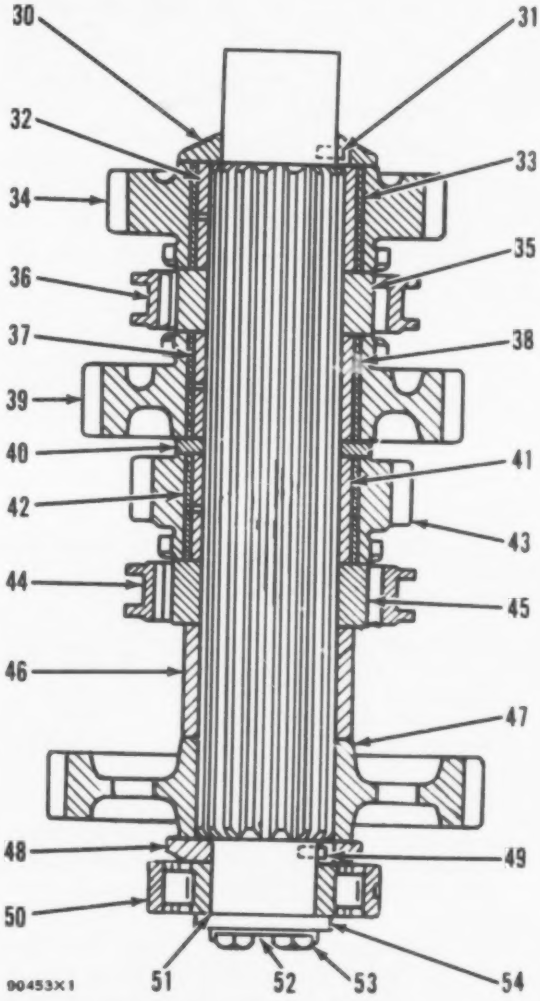
17. Install gear (47), sleeve (46), gear (45), collar (44), and sleeve (41).

18. Install bushing (42) into gear (43). Install gear (43) over sleeve (41). Install spacer (40) and sleeve (37).

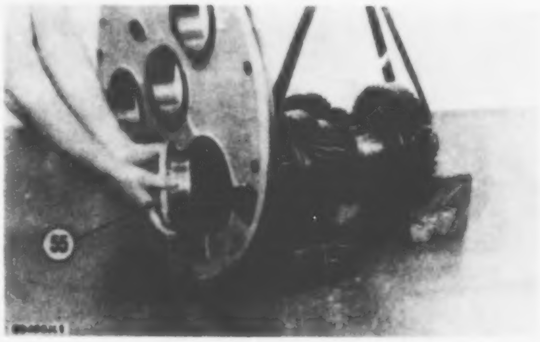
19. Install bushing (38) into gear (39). Install gear (39) over sleeve (37). Install gear (35), collar (36), and sleeve (32).

20. Install bushing (33) into gear (34). Install gear (34) over sleeve (32).

21. Install pin (31) in the shaft. Put the groove (slot) in spacer (30) in alignment with the pin and install it on the shaft.



22. Fasten a hoist to the shaft and its gears (right countershaft). Put the right countershaft in alignment with its bore in the front cover. Make sure the teeth of gears (47), (43), (39), and (34) for the right countershaft, respectively, engage the teeth of gears (8), (19), (20), and (21) of the upper shaft. Install bearing cage (55) in the bore over the right countershaft. Install the bearing assembly in the bearing cage. Follow the procedure in Step 13 when installing the bearing assembly.



TRANSMISSION (DIRECT DRIVE)

23. Put the groove in spacer (74) in alignment with the pin (75) and install it on the shaft (77).

24. Heat the inner race and roller assembly (76) in oil to a maximum temperature of 275°F (135°C) and install it on the shaft.

25. Install retainer (80), lock (79), and two bolts (78).

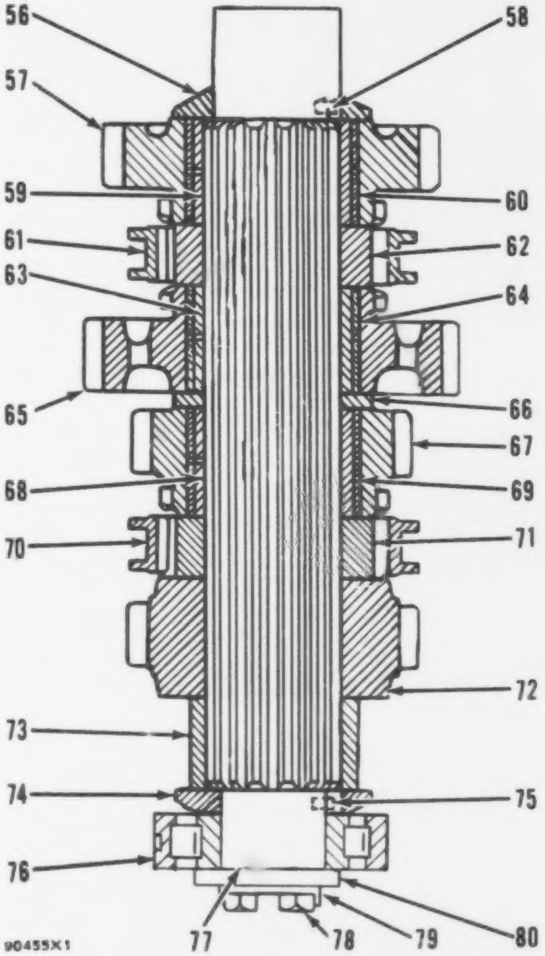
26. Install sleeve (73), gear (72), gear (71), collar (70), and sleeve (68).

27. Install bushing (69) in gear (67). Install gear (67) over sleeve (68). Install spacer (66). Install sleeve (63).

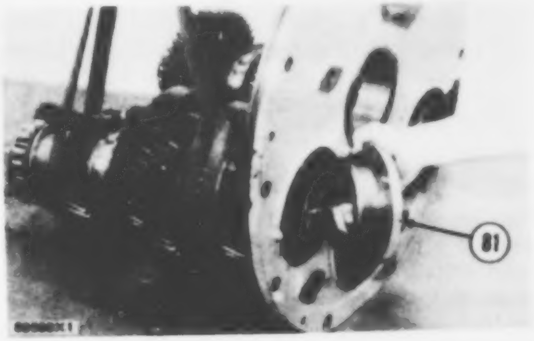
28. Install bushing (64) into gear (65). Install gear (65) over sleeve (63). Install gear (62), collar (61), and sleeve (59).

29. Install bushing (60) into gear (57). Install gear (57) over sleeve (59).

30. Install pin (58) in the shaft. Put the groove in spacer (56) in alignment with the pin and install it on the shaft.



31. Fasten a hoist to the shaft and gears (left countershaft). Put the end of the left countershaft in alignment with its bore in the front cover. Make sure the teeth of gears (72), (67), (65), and (57) for the left countershaft, respectively, engage the teeth of gears (8), (19), (20), and (21) for the upper shaft. Install bearing cage (81) in the bore over the left countershaft. Install the bearing assembly in the bearing cage. Follow the procedure in Step 13 when installing the bearing assembly.



TRANSMISSION (DIRECT DRIVE)

32. Heat the inner race and roller assembly (96) in oil to a maximum temperature of 275°F (135°C) and install it on the shaft (82).

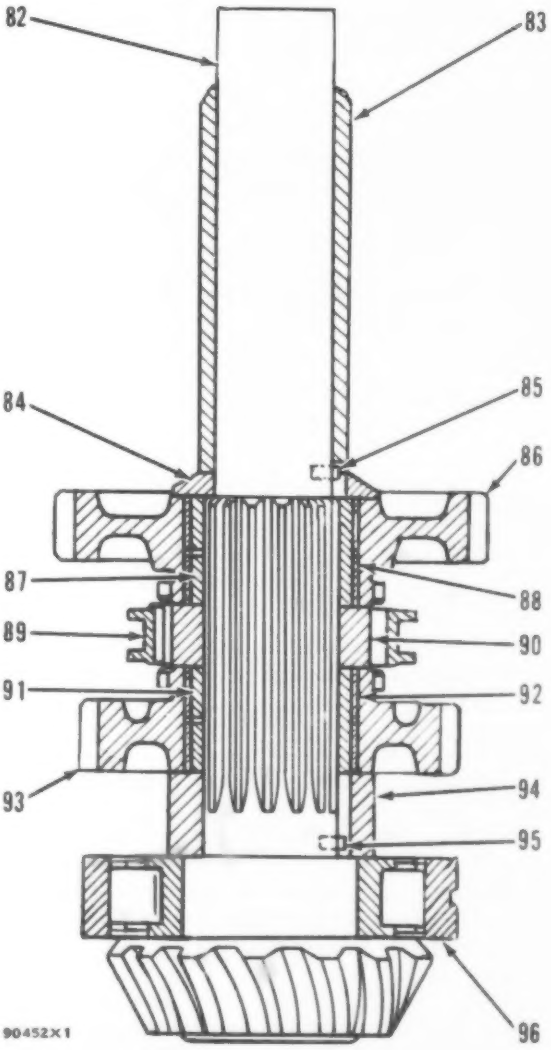
33. Put the groove in sleeve (94) in alignment with pin (95) and install it on the shaft. Install sleeve (91).

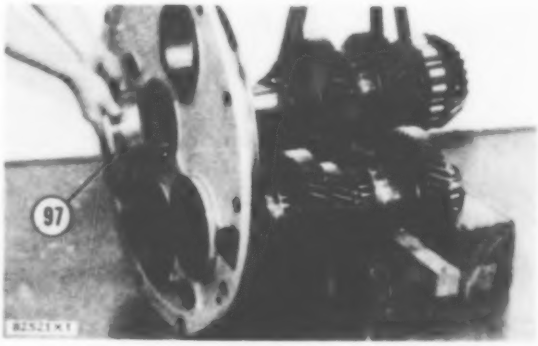
34. Install bushing (92) into gear (93). Install gear (93) over sleeve (91). Install gear (90), collar (89), and sleeve (87).

35. Install bushing (88) into gear (86). Install gear (86) over sleeve (87).

36. Install pin (85) in the shaft. Put the grooves in sleeve (84) and spacer (83) in alignment with the pin. Install the spacer and sleeve on the shaft.

37. Fasten a hoist to the shaft and gears (pinion shaft). Put the end of the pinion shaft in alignment with its bore in the front cover. Make sure the teeth of gears (93) and (86) of the pinion shaft, respectively, engage the teeth of gear (8) of the upper shaft and (47) of the right countershaft. Install the bearing cage (97) in the bore over the pinion shaft. Install the bearing assembly in the bearing cage. Follow the procedure in Step 13 when installing the bearing assembly.

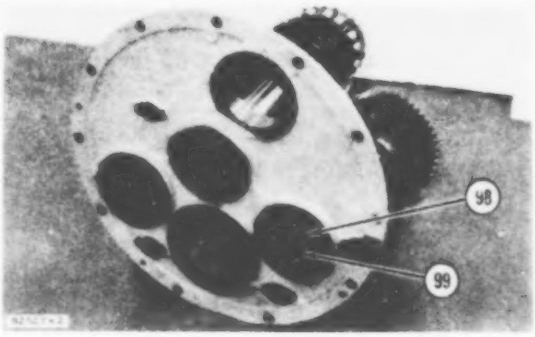




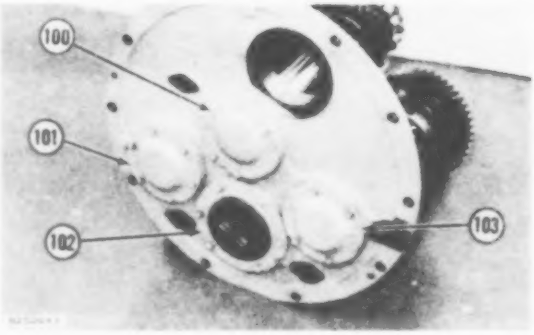
NOTE: The thickness of the shims controls the location of the pinion shaft respective to the bevel gear. If a new pinion shaft or new bearings have been installed, it will be necessary to check alignment and gear clearance (backlash) of the pinion shaft respective to the bevel gear after the transmission has been installed. See LOCATION OF BEVEL PINION and BACKLASH ADJUSTMENT in TESTING AND ADJUSTING.

TRANSMISSION (DIRECT DRIVE)

38. Install washers (98), locks, and bolts (99) on the pinion shaft, right countershaft, and left countershaft.

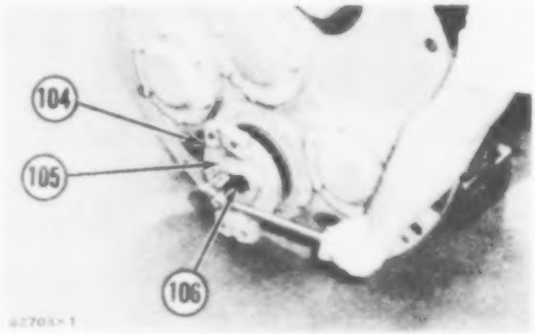


39. Remove the oil from the outer surface of the seal for the upper shaft cover. Put 7M7260 Liquid Gasket Material on the outer surface. Put a light amount of oil on the rubber lip of the seal. Install the seal in the cover (102) with tooling (D). Make sure the rubber lip of the seal is toward the rear face of the cover when the cover is installed on the transmission. Make sure the rear face of the seal is .214 in. (5.44 mm) from the rear face of the cover. Install the cover and its bolts on the bearing cage for the upper shaft.

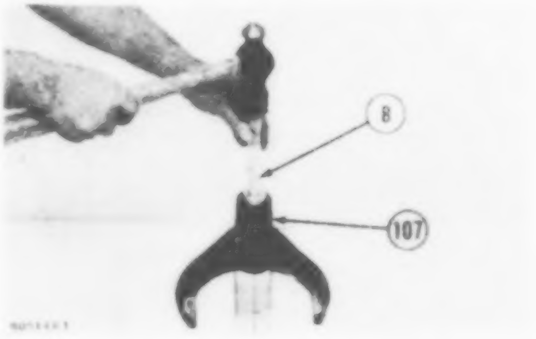


40. Install covers (100), (101), and (103) on their respective bearing cages.

41. Put the input flange (104) in position on the upper shaft. Make sure the grooves for the keys in the flange are at a 90° angle to a line through the threaded holes in the upper shaft. Install retainer (105) and two 5/8"–18NF bolts 2.75 in. (69.8 mm) long (106) on the flange. Tighten the bolts evenly until the flange is as far as it will go on the upper shaft. Remove the two bolts (106). Install the lock and the two correct bolts.

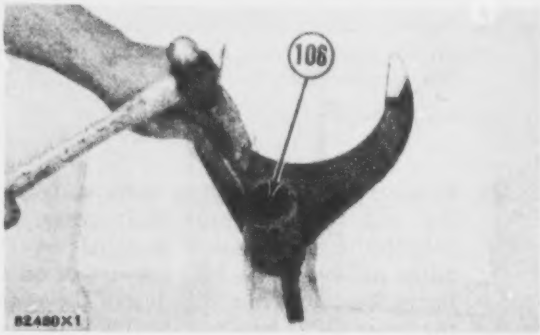


42. Install the bearings and spacers in the shift forks for first through sixth speeds with tooling (B). Make sure the spacers are between the bearings. Make sure the top of the bearings are installed .06 in. (1.5 mm) below the top of the bores in the forks. Make sure the oil holes in the spacers are in alignment with the holes (107) in the forks. Keep the bearings in position in the forks by putting three marks (staking) on each side of the forks with a hammer and punch.

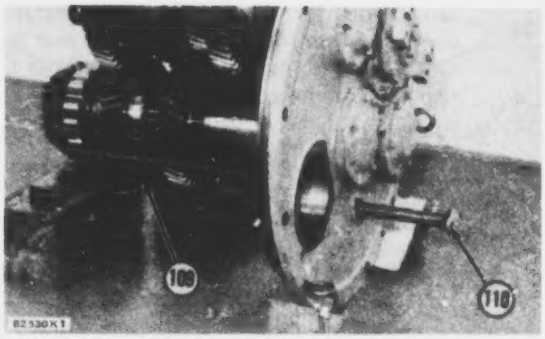


TRANSMISSION (DIRECT DRIVE)

43. Install the two bearings (108) in the shift fork for forward and reverse with tooling (A). Make sure the top of the bearings are .06 in. (1.5 mm) below the top of the bore in the fork. Keep the bearings in position by putting three marks (staking) on each side of the forks with a hammer and punch.

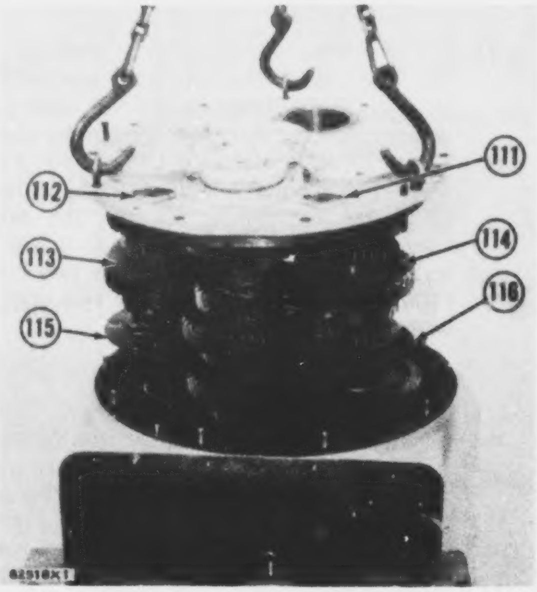


44. Put the shift fork (109) for forward and reverse in position on the collar on the pinion shaft. Install shaft (110) in its bores in the front cover and the shift fork. Install the bolts that hold the shaft to the front cover.



45. Put shift forks (113) and (115) in position on the collars on the left countershaft. Install shaft (112) in its bores in the front cover and shift forks.

46. Put shift forks (114) and (116) in position on the collars on the right countershaft. Install shaft (111) in its bores in the front cover and shift forks.

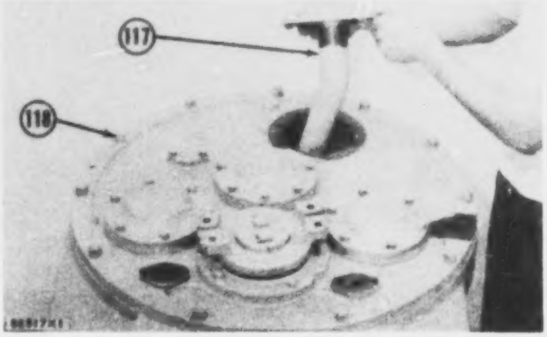


47. Install three 1/2"–13NC forged eyebolts in the front cover. Fasten a hoist to it. Put the front cover and shafts as a unit in position over the transmission case. Install two 1/2"–13NC forcing screws in the front cover. Lower the unit until the forcing screws are in contact with the case. Remove the hoist and eyebolts. Lower the unit with the forcing screws making sure that all shafts and bearings are in alignment with their bores and races in the case. Make sure the shafts for the shift forks engage in their bores in the case. Make sure the ring in the spacer for the upper shaft engages in the oil manifold on the case.

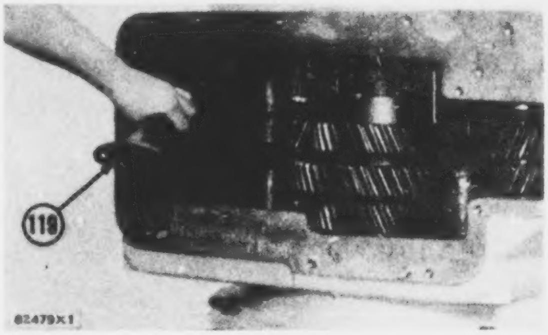
TRANSMISSION (DIRECT DRIVE)

48. Install the nuts (118) that hold the front cover to the case.

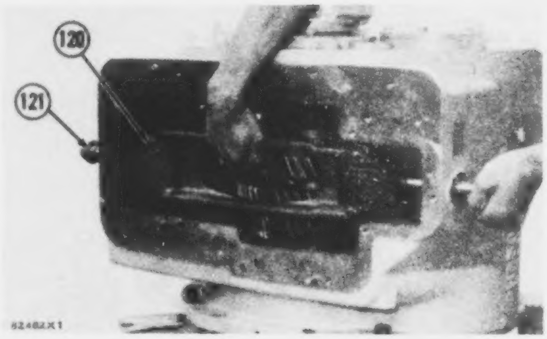
49. Put oil tube (117) in position on the front cover. Make sure the lower end of the tube is in alignment with its hole in the rear of the case. Install the bolts that hold it.



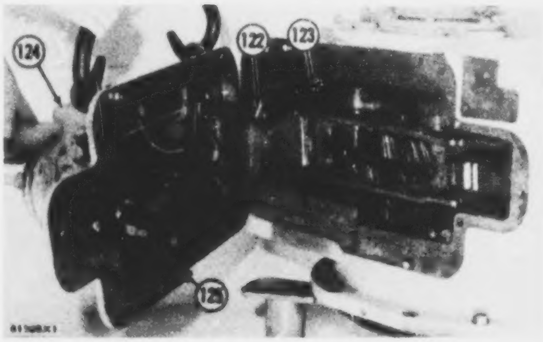
50. Put the control fork (119) for forward and reverse in position in the case. Make sure the end of the fork engages in its bearing at the bottom of the case. Make sure the block of the shift fork for forward and reverse engages in the slot in the control fork. Install the bolts that holds the flange of the control fork to the case.



51. Put the speed selector gate (120) in position in the transmission. Install two shafts (121) through the case and into the arm. Install the bolt that holds each shaft to the case.



52. Fasten a hoist to the gearshift and interlock mechanism cover assembly (124) and put it in position on the transmission. Make sure block (122) engages in the hole in the control fork (123). Make sure the speed selector arm (125) engages in the holes in the speed selector gate. Install the bolts that hold the cover assembly to the transmission case.



end by:
a) install transmission (direct drive)

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CHAPTER 4
VEHICLE SYSTEMS

CATERPILLAR

SPECIAL INSTRUCTION

INSTALLING 8S (29V, 60V, 68V) AND 8U (30V, 69V, 34W) BULLDOZERS

6052

MONTAGE DES BULLDOZERS 8S (29V, 60V, 68V) ET 8U (30V, 69V, 34W)

EINBAU DER PLANIEREINRICHTUNGEN 8S (29V, 60V, 68V) UND 8U (30V, 69V, 34W)

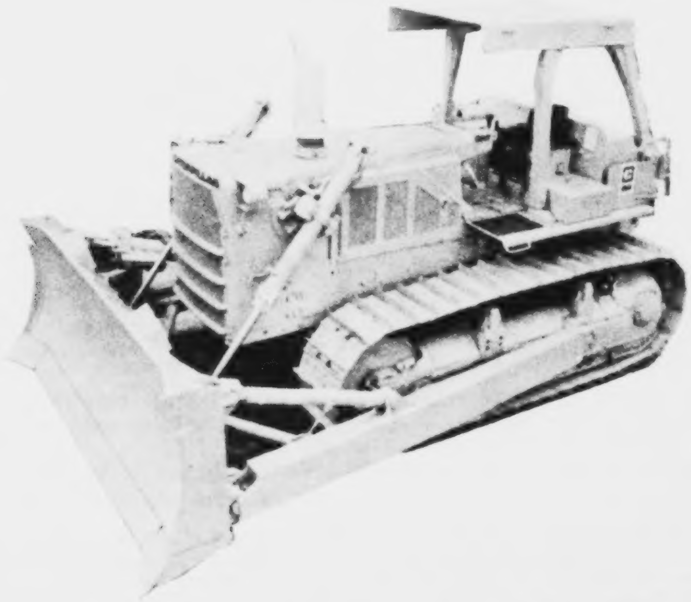
INSTALACION DE HOJAS TOPADORAS 8S (29V, 60V, 68V) Y 8U (30V, 69V, 34W)

D8K 66V, 76V, 77V

Dimensions in inches (mm) - Cotes en pouces (mm) - Abmessungen in Zoll (mm) - Dimensiones en pulgadas (mm)

Torques in lb-ft (mkg) (Nm) - Serrages en pieds-livres (mkg) (Nm)

Anzugsmomente in lb-ft (mkg) (Nm) - Par de apriete en lb-pie (mkg) (Nm)



1 Remove the muffler, precleaner and hood. Remove enough coolant from the radiator to permit removal of the radiator upper hose and the heat indicator tube.

Déposer le pot d'échappement, le préfiltre et le capot. Vider suffisamment de liquide réfrigérant du radiateur pour que l'on puisse enlever le tuyau souple supérieur de radiateur et le tuyau du thermomètre.

Auspuff, Vorabscheider und Motorhaube ausbauen. Genügend Kühlmittel aus dem Kühler ablassen, damit die Wassertemperatur-Anzeigenleitung und der obere Kühlerschlauch ausgebaut werden können.

Remueva el silenciador, el antefiltro y la capota. Remueva la cantidad necesaria de refrigerante del radiador para permitir la remoción de la manguera superior del radiador y el tubo del indicador de temperatura.

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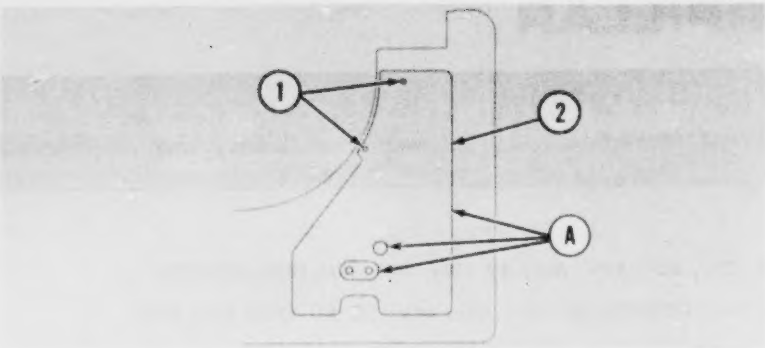
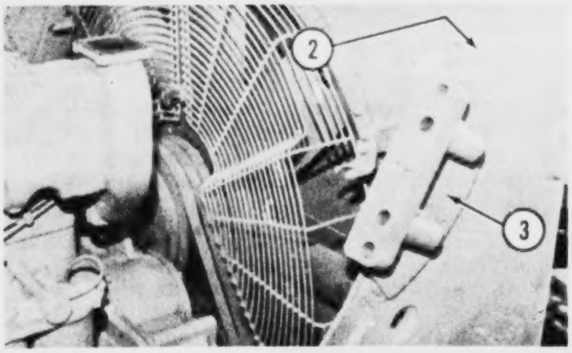


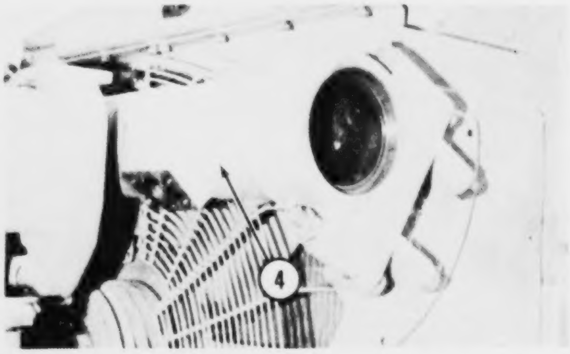
❷ Install bolts in holes (1) to hold plate (2) in position on the radiator guard. Make a .10" (2.5) square groove weld followed by a .19" (4.8) fillet weld all around plate edges (A). Remove the bolts from the plates.

Monter les vis dans les trous (1) pour tenir la plaque (2) positionnée sur le protège-radiateur. Souder chaque plaque par un cordon de remplissage de 0.10" (2,5) sur gorge à bords d'équerre que l'on recouvrira d'un cordon de 0.19" (4,8) à fond d'angle se prolongeant tout autour du bord (A) des plaques. Enlever les vis de positionnement.

Schrauben in die Bohrungen (1) einführen und Platte (2) an der Kühlerverkleidung halten. Plattenkanten (A) rundum mit 0,10" (2,5) Vierkantnaht und 0,19" (4,8) Kehlnaht schweißen. Schrauben aus den Platten ausbauen.

Instale pernos en las perforaciones (1) para sujetar la plancha (2) en posición en la protección del radiador. Haga soldadura de ranura cuadrada de 0,10" (2,5) seguida de una soldadura de filete de 0,19" (4,8) en todo el rededor de las planchas (A). Remueva los pernos de las planchas.



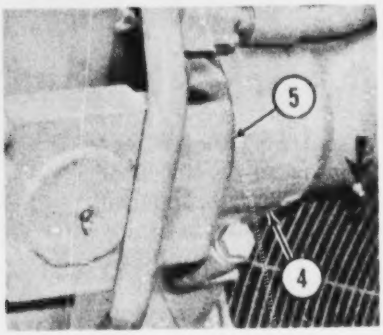


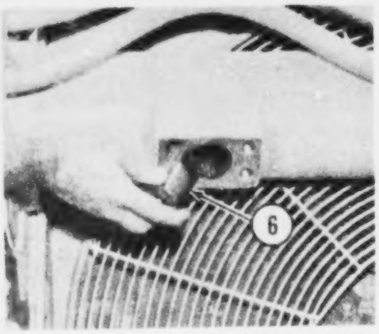
❸ Use the bolts to put bracket (3) in position on plates (2). Install tube (4) on brackets (3). Use a .10" (2.5) square groove weld followed by a .25" (6.3) fillet weld around the bracket edges to fasten the brackets to the plates. Remove tube (4). Put a .10" (2.5) square groove weld followed by a .19" (4.8) fillet weld on the inner side of the bracket. Remove the bolts from the brackets. Install tube (4).

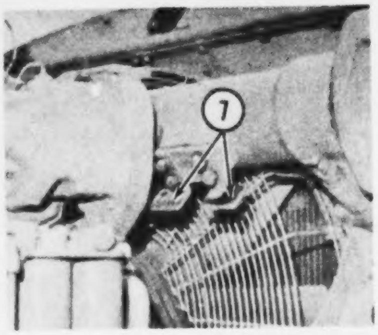
Positionner le support (3) sur les plaques (2) par les vis. Monter le tube (4) sur les supports (3). Souder les supports aux plaques par un cordon de remplissage de 0.10" (2,5) sur gorge à bords d'équerre que l'on recouvrira d'un cordon de 0.25" (6,3) à fond d'angle se prolongeant tout autour du bord du support. Enlever le tube (4). Combler le jour par un cordon de soudure de 0.10" (2,5) sur gorge à bords d'équerre que l'on recouvrira d'un cordon de 0.19" (4,8) à fond d'angle sur le côté intérieur du support. Enlever les vis du support. Monter le tube (4).

Bügel (3) mit Schrauben an den Platten (2) anbringen. Rohrträger (4) an den Bügeln (3) anbauen. Bügel mit 0,10" (2,5) Vierkantnaht und dann mit 0,25" (6,3) Kehlnaht rundum an den Platten anschweißen. Rohrträger (4) ausbauen. Bügel innen mit 0,10" (2,5) Vierkantnaht und dann mit 0,19" (4,8) Kehlnaht schweißen. Schrauben aus den Bügeln ausbauen. Rohrträger (4) einbauen.

Use los pernos para colocar la abrazadera (3) en posición en las planchas (2). Instale el tubo (4) en las abrazaderas (3). Haga soldadura de ranura cuadrada de 0,10" (2,5) seguido de soldadura de filete de 0,25" (6,3) alrededor de las abrazaderas para unirlas a las planchas. Remueva el tubo (4). Haga soldadura de ranura cuadrada de 0,10" (2,5) seguido de soldadura de filete de 0,19" (4,8) en el lado interior de la abrazadera. Remueva los pernos de las abrazaderas. Instale el tubo (4).





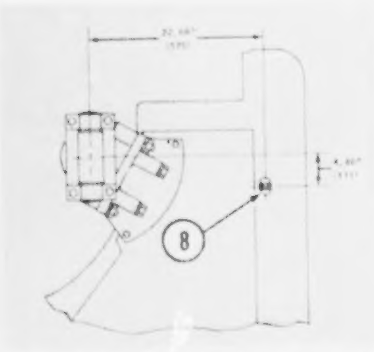


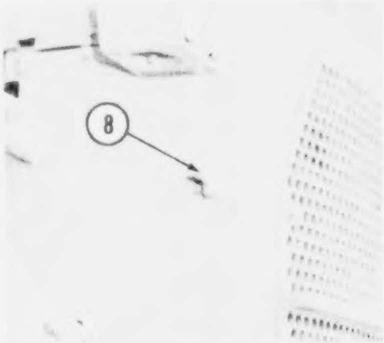
❹ Fill the ends of tube (4) with grease. Put a seal on each yoke (5) and install the yokes in the tube. Install pins (6) in the tube to hold the yokes in place. Install gasket and covers to hold the pins in place. On the right side only, install brackets (7) over the cover. Install the grease fittings.

Remplir de graisse les extrémités du tube (4). Placer une bague d'étanchéité sur chaque étrier (5) et monter les étriers dans le tube. Monter les dés (6) dans le tube pour arrêter les étriers. Monter le joint et les couvercles pour retenir les dés. Du côté droit seulement, monter les supports (7) sur le couvercle. Monter les graisseurs.

Rohrträger (4) mit Schmierfett füllen. Dichtungen auf die Joche (5) aufziehen und Joche in den Rohrträger einbauen. Bolzen (6) in den Rohrträger einbauen und Joche sichern. Dichtungen und Deckel einbauen und Bolzen sichern. Nur auf der rechten Seite zwei Bügel (7) über den Deckel einbauen. Schmiernippel einbauen.

Llene los extremos del tubo (4) con grasa. Coloque un sello en cada horquilla (5) e instale las horquillas en el tubo. Instale pasadores (6) en el tubo para sujetar las horquillas en posición. Instale empaquetadura y tapas para sujetar los pasadores en posición. En el lado derecho solamente, instale abrazaderas (7) sobre la tapa. Instale las graseras.



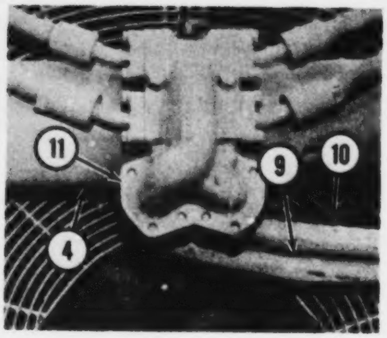


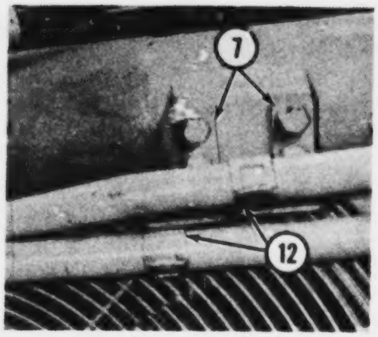
❺ Put pins (8) in the position shown and make a .19" (4.8) bevel groove weld followed by a .31" (7.8) fillet weld to fasten the pins to the radiator guard.

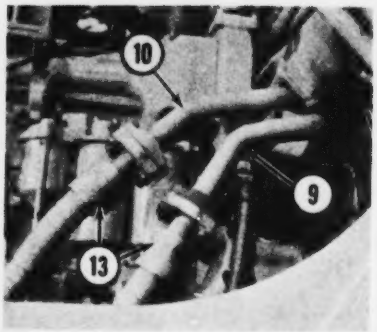
Monter les broches (8) à la position représentée et souder par un cordon de 0.19" (4,8) sur gorge biseautée que l'on recouvrira d'un cordon à fond d'angle de 0.31" (7,8) pour fixer les broches au protège-radiateur.

Bolzen (8), wie gezeigt, anbringen und zuerst mit 0,19" (4,8) Keilnaht, dann mit 0,31" (7,8) Kehlnaht an der Kühlerverkleidung anschweißen.

Coloque pasadores (8) en la posición que se muestra y haga soldadura de bisel de 0,19" (4,8) seguido de soldadura de filete de 0,31" (7,8) para unir los pasadores a la protección del radiador.





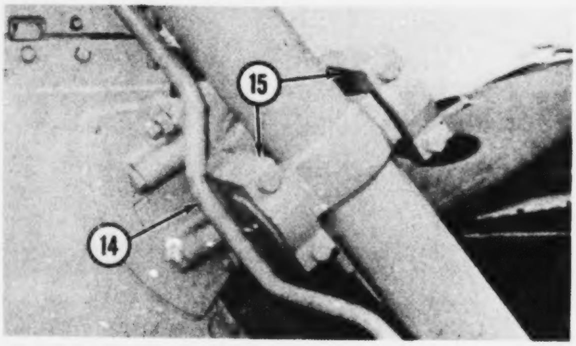


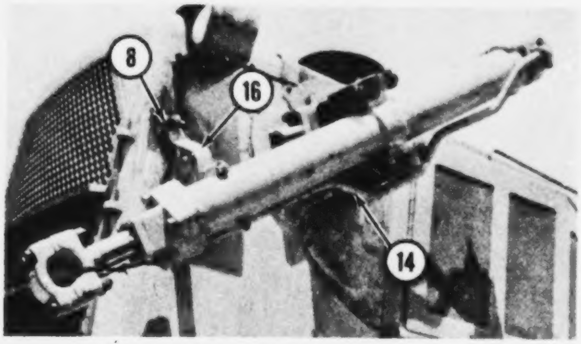
⑥ Install tubes (9) and (10) on manifold (11). Install the manifold on tube (4). Use clips (12) to hold the tubes on brackets (7). Using flanges and seals, connect tubes (9) and (10) to hoses (13).

Monter les tuyaux (9) et (10) sur le collecteur (11). Monter le collecteur sur le tube (4). Attacher les tuyaux aux supports (7) à l'aide des colliers (12). Brancher les tuyaux (9) et (10) sur les flexibles (13) à l'aide des brides et joints.

Leitungen (9) und (10) am Ölverteiler (11) anbauen. Ölverteiler am Rohrträger (4) anbauen. Leitungen mit Klemmen (12) an den Bügeln (7) sichern. Leitungen (9) und (10) mit Flanschen und Dichtungen an den Schläuchen (13) anschließen.

Instale tubos (9) y (10) en el múltiple (11). Instale múltiple en el tubo (4). Use grampas (12) para sujetar los tubos en las abrazaderas (7). Usando las bridas y sellos, conecte los tubos (9) y (10) a las mangueras (13).



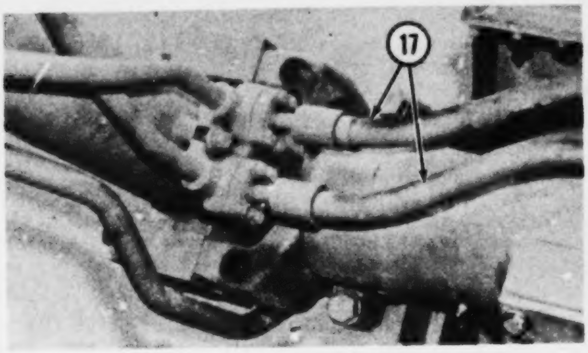


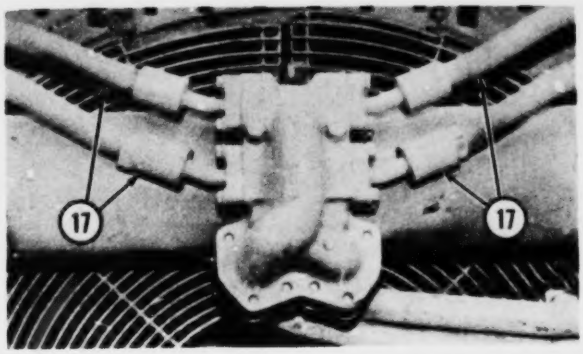
⑦ Remove tube assemblies (14) from the lift cylinders. Install caps (15) and install the cylinders to the yokes. Install tube assemblies (14). Fasten the cylinders to pins (8) with links (16) as shown. Install the grease fittings.

Déposer les tuyaux (14) des vérins de levage. Monter les chapeaux (15) et monter les vérins sur les étriers. Remonter les tuyaux (14). Attacher les vérins aux axes (8) à l'aide des supports (16) comme représenté. Monter les graisseurs.

Leitungen (14) von den Hubzylindern abbauen. Deckel (15) einbauen und Zylinder in die Joche einbauen. Leitungen (14) wieder einbauen. Zylinder mit Stützgliedern (16), wie gezeigt, an den Bolzen (8) anbringen. Schmiernippel einbauen.

Remueva los conjuntos de tubo (14) de los cilindros de levantamiento. Instale tapas (15) e instale los cilindros a las horquillas. Instale tubos (14). Una los cilindros a los pasadores (8) con conexiones (16), como se muestra. Instale las graseras.





8 Install four hoses (17) as shown using seals, flanges, lockwashers and bolts.

Monter les quatre flexibles (17) comme représenté en utilisant les joints, brides, rondelles Grower et vis nécessaires.

Vier Schläuche (17), wie gezeigt, mit Dichtungen, Flanschen, Federscheiben und Schrauben einbauen.

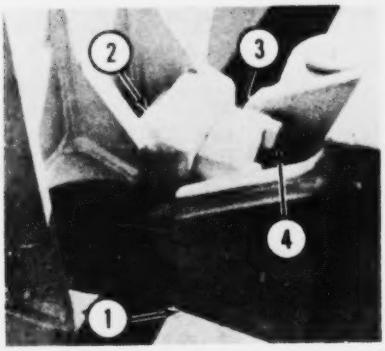
Instale cuatro mangueras (17), como se muestra, usando sellos, bridas, arandelas de presión y pernos.

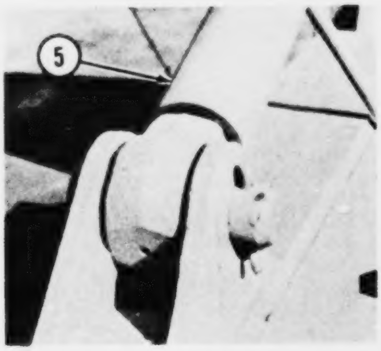
ASSEMBLY OF BLADE

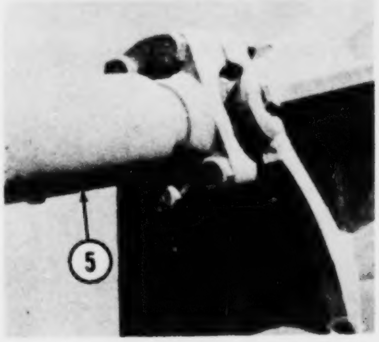
ASSEMBLAGE DE LA LAME

ZUSAMMENBAU DES PLANIERSCHILDES

ARMADO DE LA HOJA





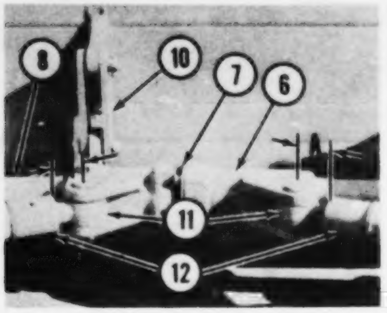


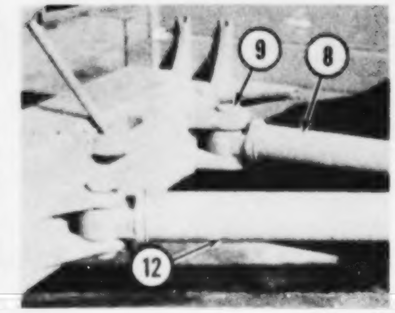
1 Remove all paint and dirt from the bearing surfaces. Install push arms (1) using retainers (2), caps (3) and bolts (4) as shown. If the machine is equipped with a tilt cylinder, install brace (5) on the left push arm only.

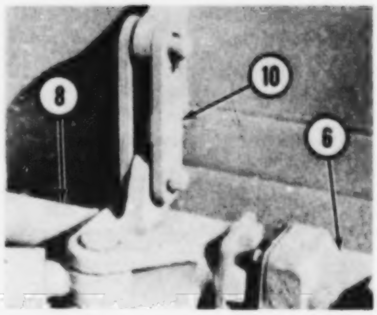
Enlever toute la peinture et nettoyer les portées de montage. Monter les bras de poussée (1) en utilisant des arrêtoirs (2), chapeaux (3) et vis (4) comme représenté. Si la machine comporte un vérin de commande d'inclinaison, monter le tirant (5) sur le bras de poussée de gauche seulement.

Lagerflächen gründlich von Schmutz und Farbresten säubern. Schubarme (1) mit Haltern (2), Deckeln (3) und Schrauben (4), wie gezeigt, einbauen. Wenn die Maschine mit einem Neigezylinder ausgerüstet ist, Strebe (5) am linken Schubarm einbauen.

Remueva toda la pintura y suciedad de las superficies de contacto. Instale brazos de empuje (1) usando retenes (2), tapas (3) y pernos (4), como se muestra. Si la máquina está equipada con cilindro de inclinación, instale tirante (5) en el brazo de empuje izquierdo solamente.







2 Install the bearing in strut (6); install retainer (7), bolts and washers. Push the end of strut (8) through the bearing into strut (6). Connect struts (6) and (8) to the push arms with pins (9) and cotter pins. Install link (10), screws (11) and braces (12). Keep both dimensions (A) the same during any adjustment. Adjust braces (12) until the ends of the push arms will fit the tractor trunnions.

Monter le jeu de coussinets sphériques dans le tirant (6). Fixer la plaque de retenue (7) par des vis avec rondelles d'arrêt. Faire passer l'extrémité du tirant (8) à travers le coussinet sphérique et pousser jusqu'à l'engager dans le tirant (6). Assembler les tirants (6) et (8) aux bras de poussée avec les axes (9) et goupilles. Monter la biellette (10), les vis (11) et bras de raidissement (12). S'assurer que les cotes "A" sont égales, des deux côtés, après tout réglage. Régler les bras de raidissement (12) jusqu'à ce que les extrémités des bras de poussée puissent s'engager sur les tourillons du tracteur.

Lager in die Querstrebe (6) einbauen; Halter (7), Schrauben und Beilagen einbauen. Ende der Querstrebe (8) durch das Lager in die Querstrebe (6) einschieben. Querstreben (6) und (8) mit Bolzen (9) und Splinten an den Hubarmen anschließen. Bügel (10), Schraubköpfe (11) und Stützen (12) einbauen. Beide Maße (A) müssen bei allen Einstellungen gleich bleiben. Stützen (12) nachstellen, bis die Schubarmenden an die Montagezapfen der Maschine passen.

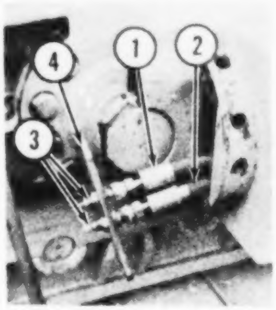
Instale el cojinete en el tirante (6); instale el retén (7), pernos y arandelas de presión. Empuje el extremo del tirante (8) a través del cojinete en el tirante (6). Conecte los tirantes (6) y (8) a los brazos de empuje con pasadores (9) y chavetas partidas. Instale la conexión (10), tornillos (11) y tirantes (12). Mantenga ambas dimensiones (A) iguales durante cualquier ajuste que se haga. Ajuste los tirantes (12) hasta que los extremos de los brazos de empuje ajusten en los muñones del tractor.

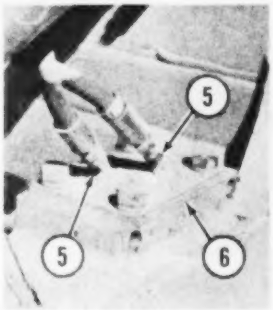
BLADE TILT CYLINDER

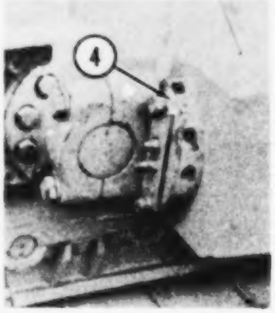
SCHILDNEIGEZYLINDER

VÉRIN D'INCLINAISON DE LAME

CILINDRO DE INCLINACION DE LA HOJA





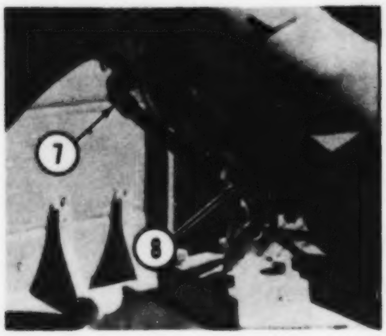


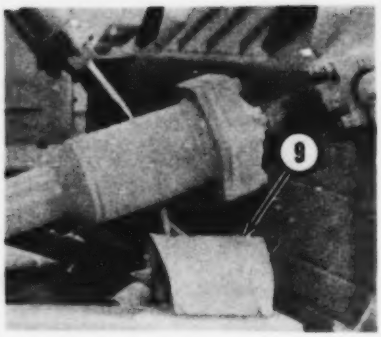
1 Install the tilt cylinder with shims as necessary. Install hoses (1) and (2) through the push arm. Install connectors (3) and nuts to plate (4). Install elbows (5) and nuts to plate (6). Connect hoses (1) and (2) to the connectors and elbows so hose (1) is connected between the upper connector (3) and the rear elbow (5). Install plates (4) and (6) with 7M7260 Gasket Cement, bolts and lockwashers.

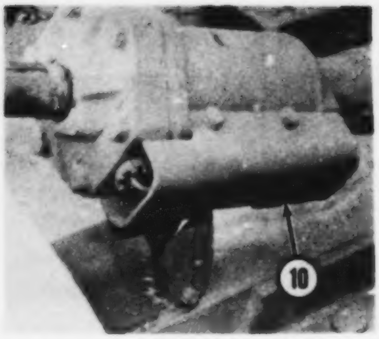
Monter le vérin d'inclinaison avec les cales nécessaires. Faire passer les flexibles (1) et (2) dans le bras de poussée. Monter les raccords (3) et écrous sur la plaque (4). Monter les coudes (5) et écrous sur la plaque (6). Brancher les flexibles (1) et (2) aux raccords et coudes de façon que le flexible (1) relie le raccord supérieur (3) au coude arrière (5). Fixer les plaques (4) et (6) garnies d'enduit 7M7260 pour joints, par les vis et rondelles Grower.

Schildneigezylinder mit den benötigten Beilagen einbauen. Schläuche (1) und (2) durch den Schubarm führen. Anschlüsse (3) und Muttern auf der Platte (4) einbauen. Bogen (5) und Muttern auf der Platte (6) einbauen. Schläuche (1) und (2) an die Anschlüsse und Bogen so anschließen, daß der Schlauch (1) den oberen Anschluß (3) und den hinteren Bogen (5) verbindet. Platten (4) und (6) mit Dichtungskleber 7M7260, Schrauben und Federscheiben einbauen.

Instale el cilindro de inclinación con lainas en la forma necesaria. Instale mangueras (1) y (2) a través del brazo de empuje. Instale conectores (3) y tuercas a la plancha (4). Instale codos (5) y tuercas a la plancha (6). Conecte las mangueras (1) y (2) a los conectores y codos de manera que la manguera (1) esté conectada entre el conector superior (3) y el codo trasero (5). Instale las planchas (4) y (6) con Cemento para empaquetaduras 7M7260, pernos y arandelas de presión.







2 Install hoses (7) and (8) using seals, flanges, washers, and bolts. Install covers (9) and (10) as shown.

Monter les flexibles (7) et (8) en utilisant les joints, brides, rondelles et vis. Monter les couvercles (9) et (10) comme représenté.

Schläuche (7) und (8) mit Dichtungen, Flanschen, Beilagen und Schrauben einbauen. Deckel (9) und (10), wie gezeigt, einbauen.

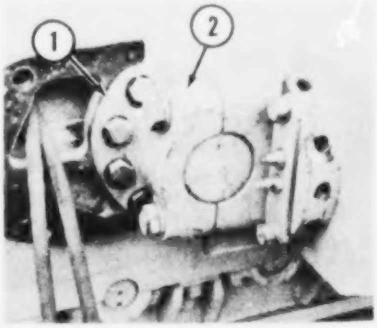
Instale mangueras (7) y (8) usando sellos, bridas, arandelas y pernos. Instale tapas (9) y (10), como se muestra.

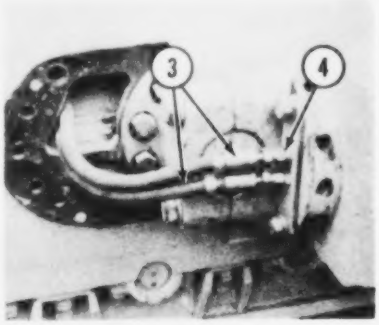
INSTALLING BLADE

POSE DE LA LAME

ANBAU DES PLANIERSCHILDES

INSTALACION DE LA HOJA



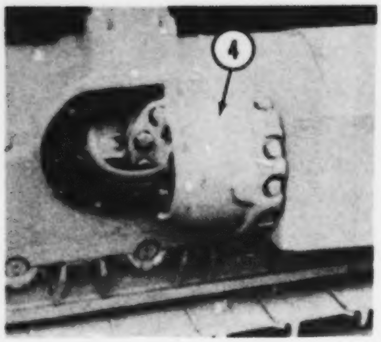


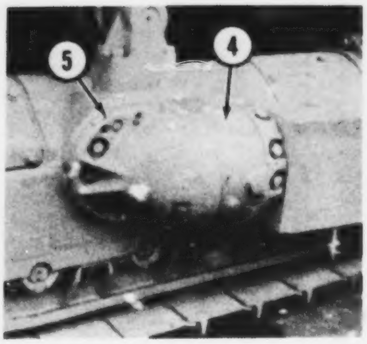
1 Remove the covers and corks from the trunnion mounting area. Clean any paint and dirt from the surfaces that will be in contact. Install trunnions (1). Move the machine between the push arms. Install bearing caps (2). Connect hoses (3) so the hose from upper fitting (4) is connected to the front tube from the hydraulic control.

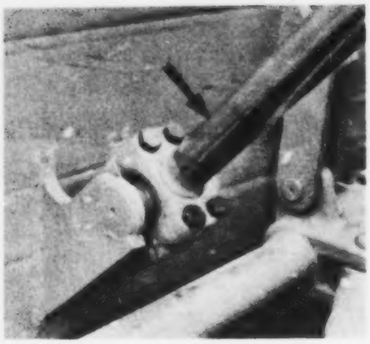
Enlever les couvercles et bouchons de liège au point de montage des tourillons. Gratter la peinture et nettoyer les surfaces d'appui de l'embase de tourillon et du longeron des châssis porteurs. Monter les tourillons (1). Engager le tracteur entre les bras de poussée. Monter les chapeaux (2). Brancher les flexibles (3) de façon que le flexible venant du raccord supérieur (4) soit branché au tuyau avant de la commande hydraulique.

Deckel und Korken von der Einbaustelle des Montagezapfens entfernen. Berührungsflächen gründlich von Schmutz und Farbresten säubern. Montagezapfen (1) einbauen. Maschine zwischen die Schubarme fahren. Lagerdeckel (2) einbauen. Schläuche (3) so anschließen, daß der Schlauch vom oberen Fitting (4) am vorderen Schlauch von der Hydrauliksteuerung angeschlossen ist.

Remueva las tapas y corchos del área de montaje del muñón. Limpie la pintura y suciedad de las superficies que hace en contacto. Instale los muñones (1). Mueva la máquina entre los brazos de empuje. Instale tapas de cojinete (2). Conecte mangueras (3), de manera que la conexión superior (4) esté conectada al tubo delantero del control hidráulico.





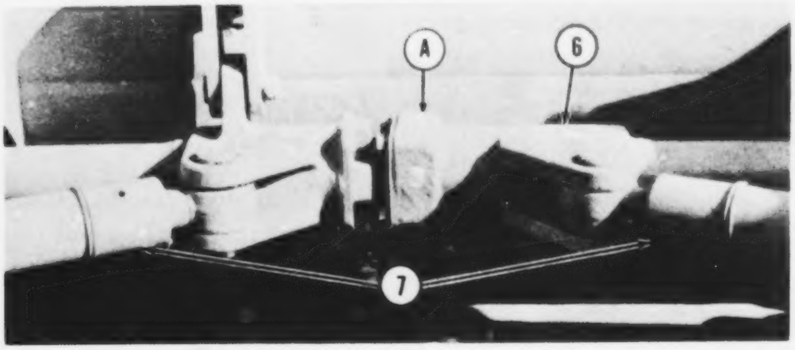


2 Install covers (4) and (5). Connect the lift cylinders to the blade with caps, bolts and nuts.

Monter les couvercles (4) et (5). Accoupler les vérins de levage à la lame et fixer les chapeaux par des vis et écrous.

Deckel (4) und (5) einbauen. Hubzylinder mit Deckel, Schrauben und Muttern am Planierschild anschließen.

Instale tapas (4) y (5). Conecte los cilindros de levantamiento a la hoja con tapas, pernos y tuercas.



3 Put a 1.50" (38.0) thick block between the blade and strut (6) at location (A). Adjust braces (7) until the strut fits loosely against the block. Remove the block. This dimension permits free movement of the blade.

Placer une cale de 1.50" (38,0) d'épaisseur entre la lame et le tirant (6) en (A). Régler la longueur des bras diagonaux (7) jusqu'à ce que le tirant touche la cale. Enlever la cale. Ce réglage est destiné à permettre à la lame de jouer sans forcer.

Einen 1,50" (38,0) dicken Block zwischen Schild und Querstrebe (6) bei (A) einlegen. Stützen (7) nachstellen, bis die Querstrebe lose am Block anliegt. Block ausbauen. Dieses Maß ermöglicht freie Schildbewegung.

Coloque un bloque de 1,50" (38,0), de espesor, entre la hoja y el tirante (6) en el punto (A). Ajuste los tirantes (7) hasta que el tirante ajuste flojo contra el bloque. Remueva el bloque. Estas dimensiones permiten el movimiento libre de la hoja.

CATERPILLAR

SPECIAL INSTRUCTION

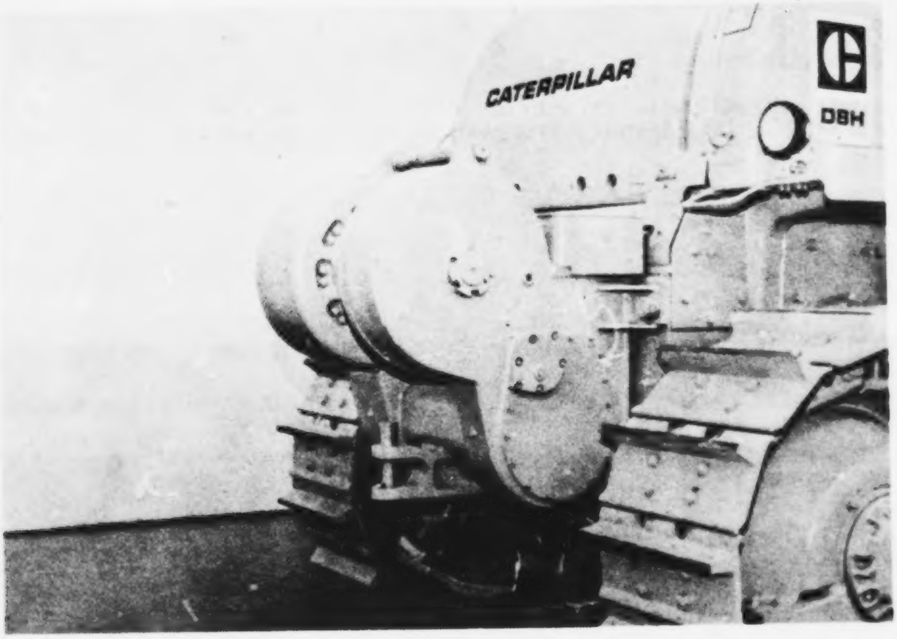
5163

INSTALLING 58 AND 59 WINCHES (32U, 33U, 34U)

D8	36A5167, 46A20559, 68A
D9	66A3266

- Dimensions in inches (mm)
- Torques in lb. ft. (mkg)
- Ø - Diameter
- R - Radius
- Pressure in psi (kg/cm^2)

c - indicates change



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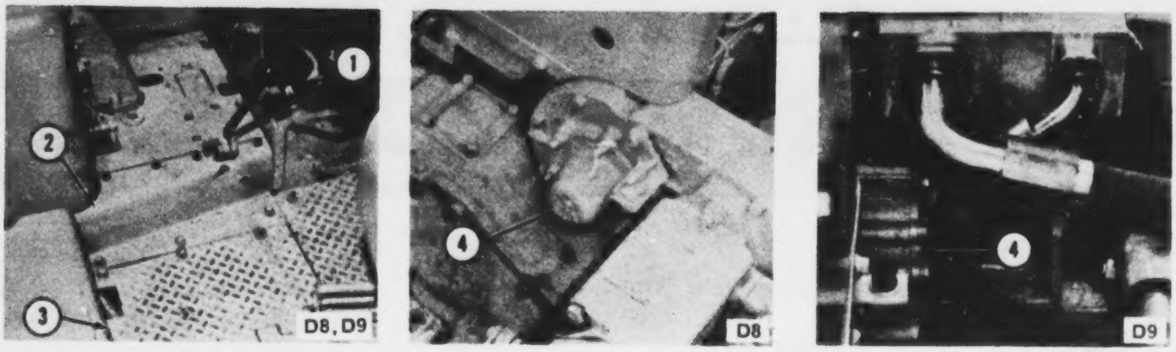
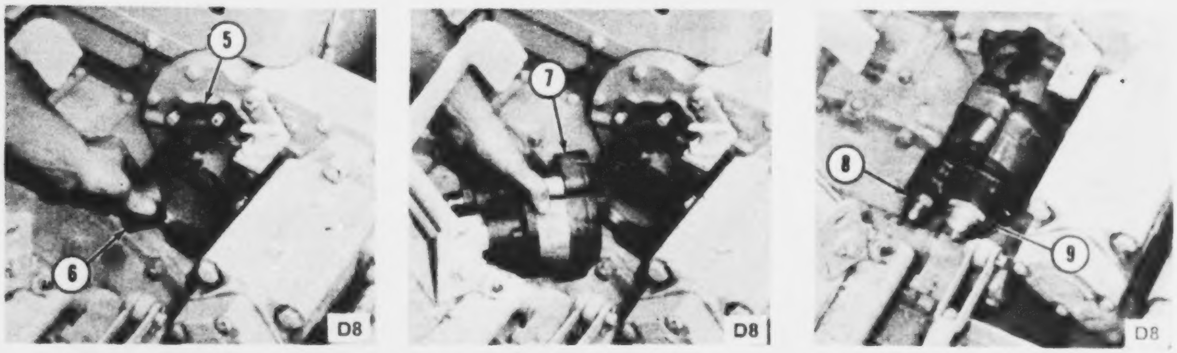
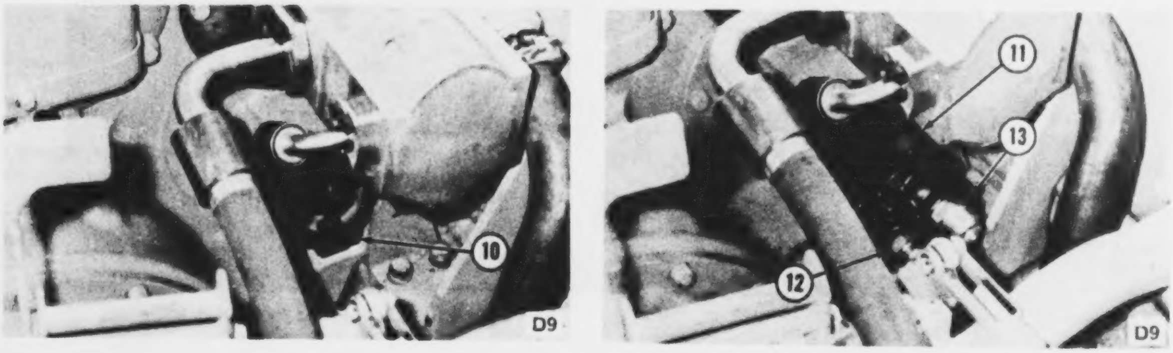

1
2
3
D8, D9
4
D8
4
D9

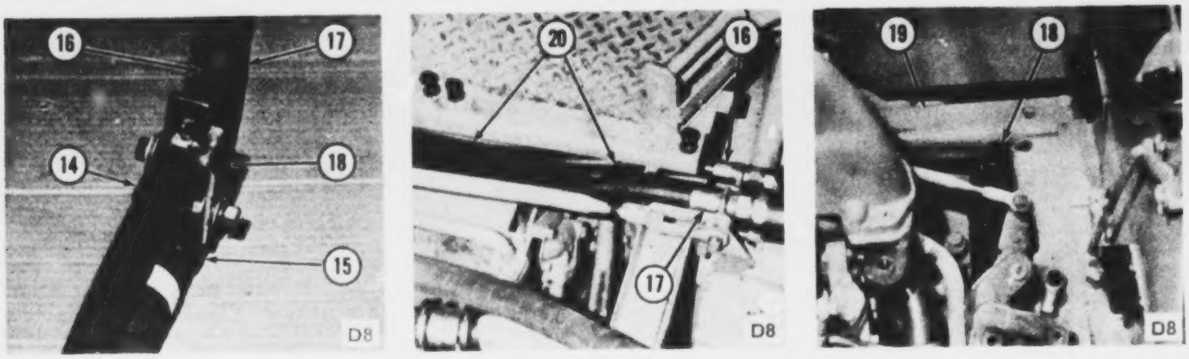
❶ D8, D9: Remove floor plates (1), (2) and (3). Remove cover (4).


5
6
D8
7
D8
8
9
D8

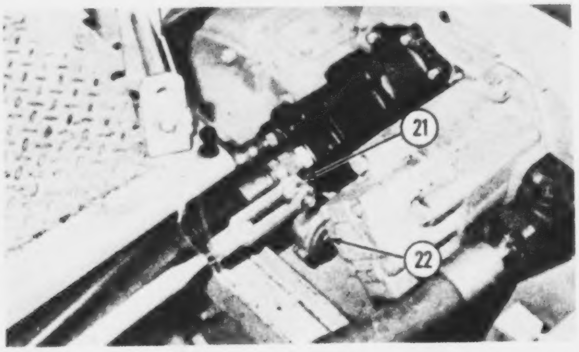
❷ D8: Install oil pump adapter (5) with new bolts, washers and a new gasket. Install coupling (6), O-ring seals and oil pump (7). Install O-ring seals on adapters (8) and (9). Install and tighten adapters (8) and (9).


10
D9
11
13
12
D9

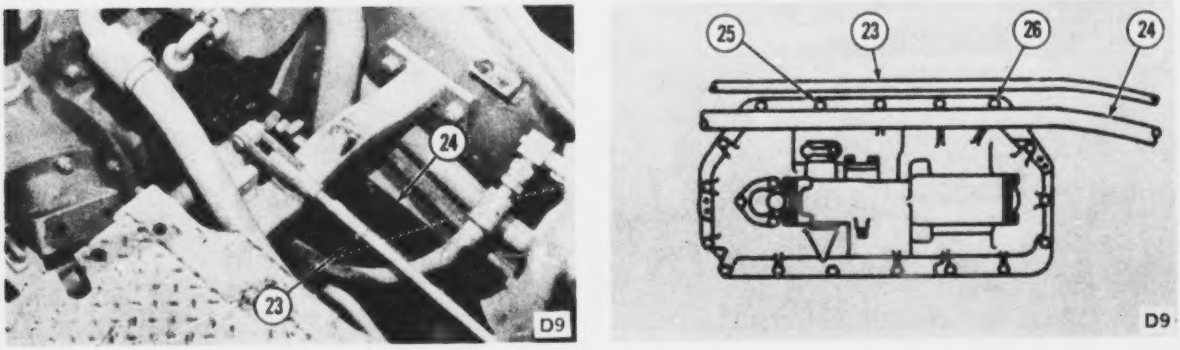
❸ D9: Install adapter (10) with new bolts, washers and gasket. Install the oil pump drive coupling and oil pump (11). Install adapters (12) and (13) with O-ring seals.


16
17
14
18
15
D8
20
16
17
D8
19
18
D8

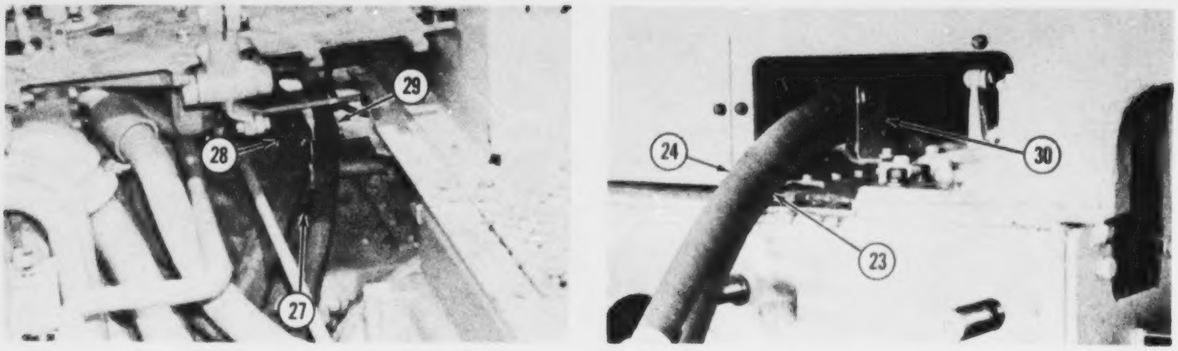
❹ D8: Put clamps (14) and (15) loosely on hoses (16) and (17). Install bracket (18) as shown. Connect hoses (16) and (17) to the oil pump. Connect bracket (18) to brace (19). Tighten hose clamps (14) and (15). Install straps (20) in the approximate locations shown.



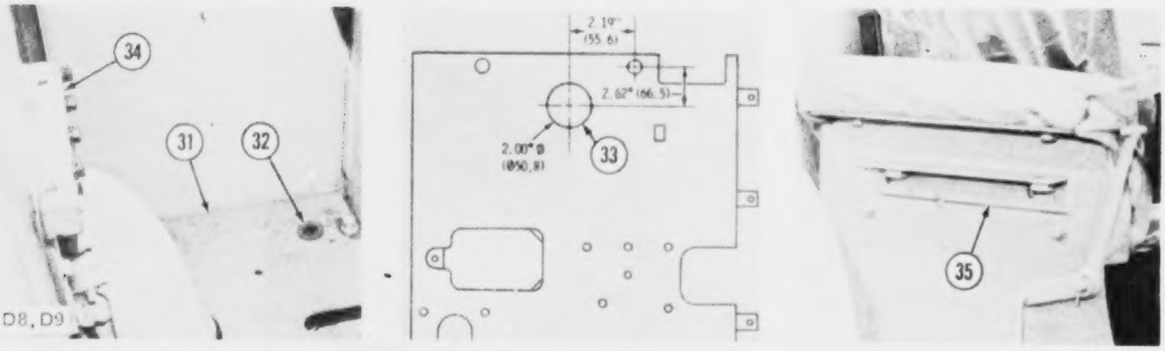
❺ D8: Remove lever (21). Install the large washer on shaft (22). Install lever (21).


24
23
D9
25
23
26
24
D9

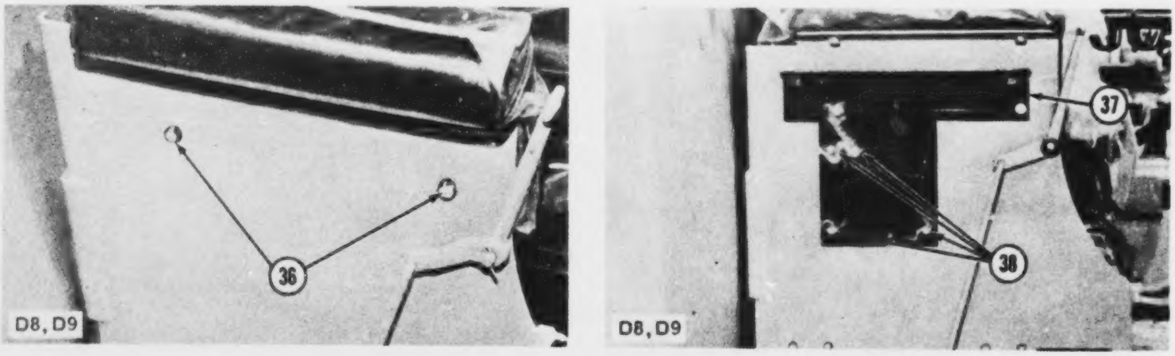
❻ D9: Install and connect hoses (23) and (24). Remove bolts (25) and (26) from the right steering clutch cover.


29
28
27
24
30
23

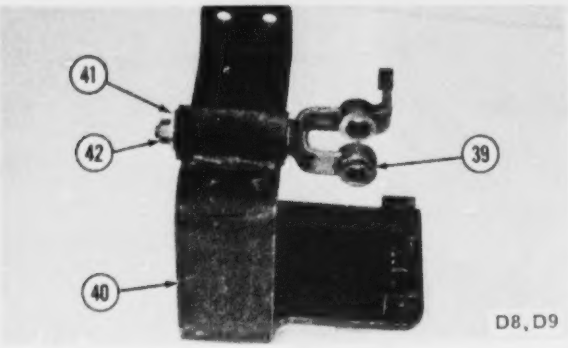
❼ D9: Install bracket (27) (smaller of the two), clamp (28), and clamp (29). Install bracket (30) and clamps on hoses (23) and (24).

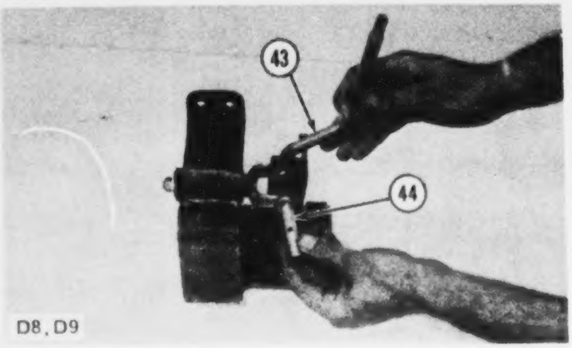

34
31
32
D8, D9
2.19"
(55.6)
2.62" (66.5)
2.00"Ø
(Ø50.8)
33
35

❽ D8: Install floor plate (31) and grommet (32). D9: Cut hole (33) in the new floor plate and install grommet (32). D8, D9: Remove four bolts and install block (34). If bracket (35) is welded to the seat frame, the bracket must be removed.

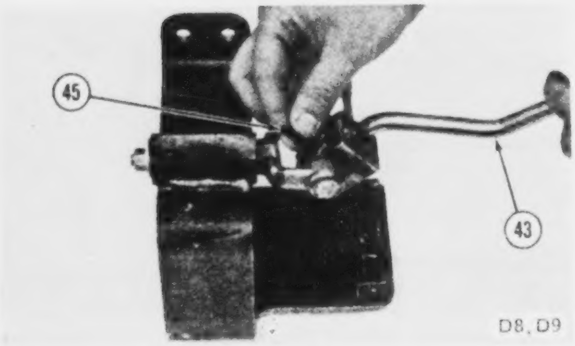

36
D8, D9
37
38
D8, D9

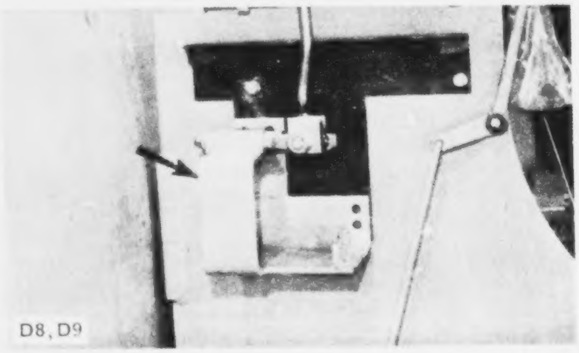
❾ D8, D9: Remove bolts (36) and install bracket (37). Drill four .438"Ø (Ø11.1) holes (38); use the holes in bracket (37) as a guide.


41
42
39
40
D8, D9

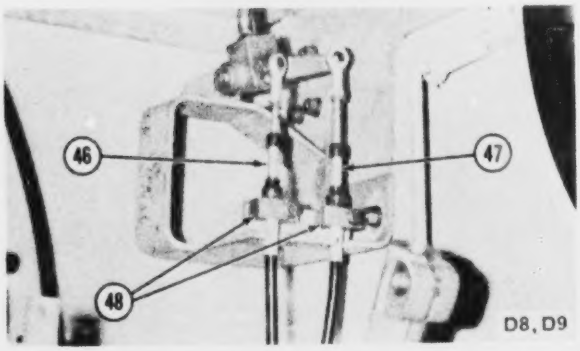


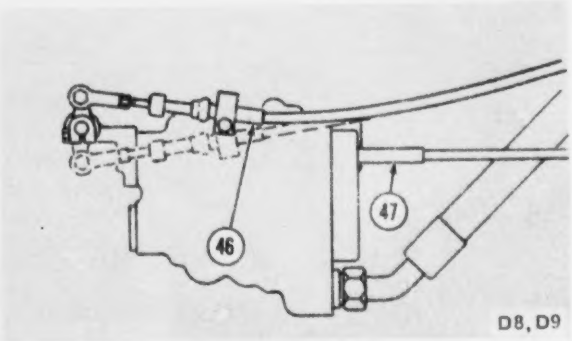
⑩ D8, D9: Install bellcrank (39) in bracket (40). Install washer (41) and locknut (42). Tighten locknut (42) until there is a minimum amount of motion to the side, and bellcrank (39) still has free rotation. Install lever (43) and shaft (44).



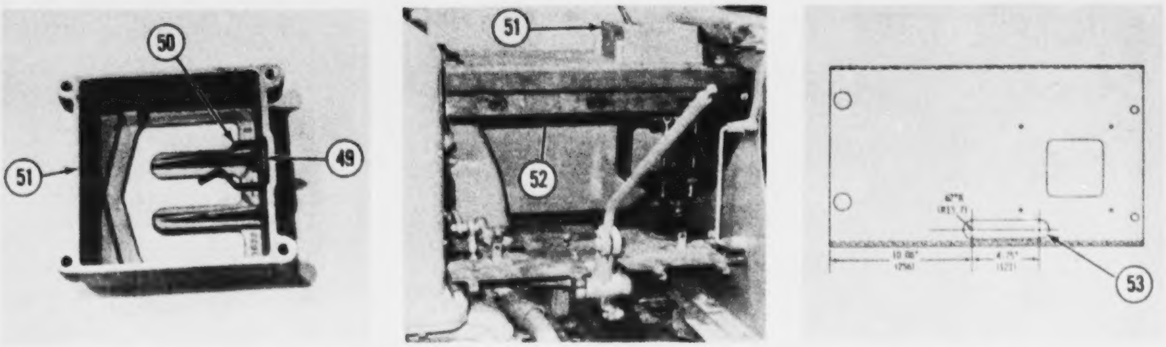


⑪ D8, D9: Install pin (45) in lever (43). Install the control group on the seat frame with bolts, washers, lockwashers and nuts.


46
47
48
D8, D9

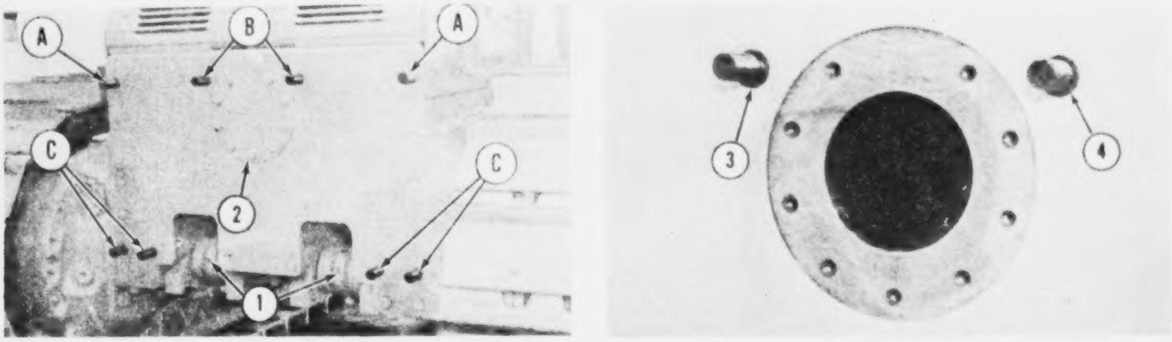


⑫ D8, D9: Install cable (46) and cable (47). Do not connect the cables to the bellcrank. Install clamps (48).

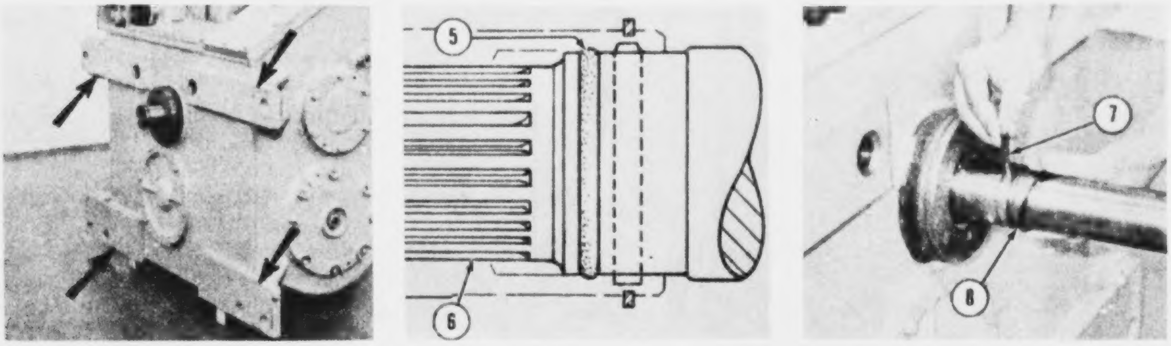


13 D8, D9: Install lug (49) and spring (clip) (50) in cover (51). Install cover (51) on plate (52). Install plate (52) on the machine. If a D9 Tractor has a rip dozer, cut slot (53) in plate (52) as shown.

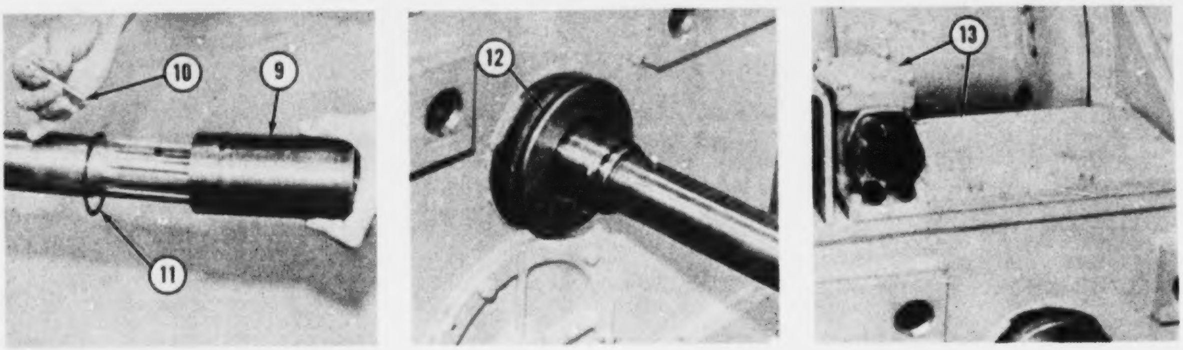
INSTALLING WINCH



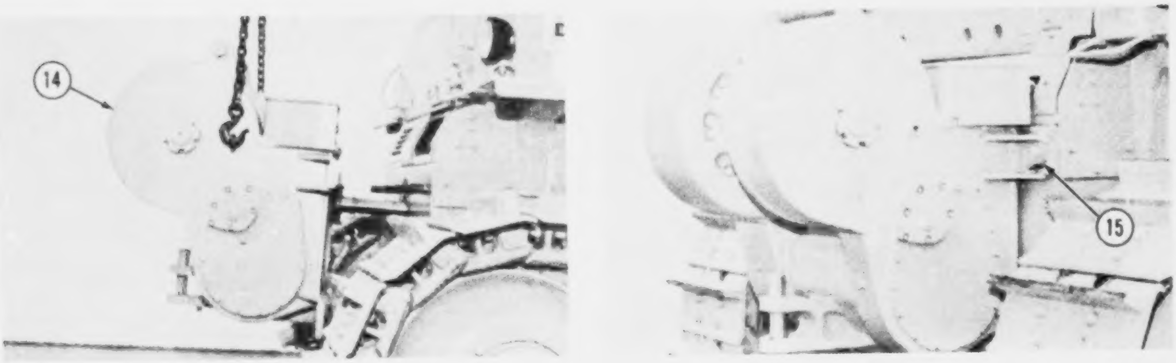
1 D8, D9: Remove the hitch and studs from the rear of the machine. Remove grease fittings (1) and install the new 90° fittings. On D8 Tractors, install two large studs at (A) and six smaller studs at (B) and (C). On D9 Tractors, install two smaller studs at (B) and six larger studs at (A) and (C). Tighten the small studs to 400 ± 40 lb. ft. (55.3 ± 5.5). Tighten the larger studs to 550 ± 50 lb. ft. (76.1 ± 6.9). Remove the serial number plate. Install the serial number plate in a similar location after installing the winch. Drill two .104"0 (02.64) holes .31" (7.87) deep for installing the serial number plate. Remove cover (2). Install seals (3) and (4). Put corks in the holes that are not used.



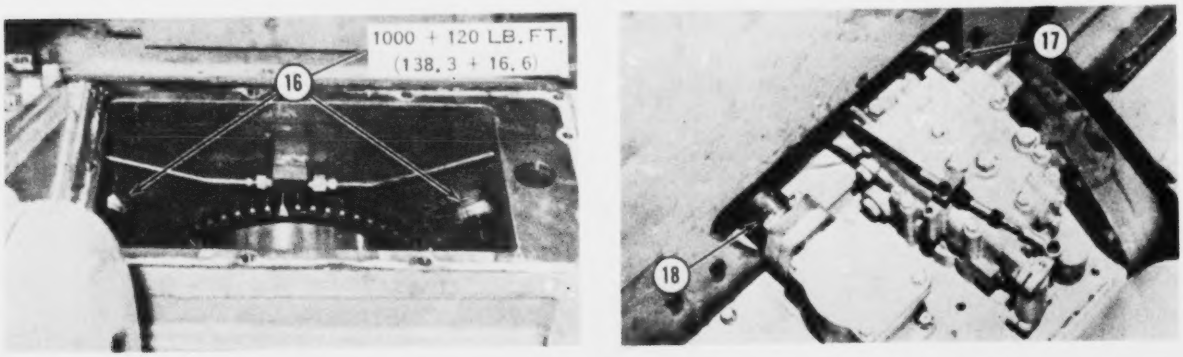
2 D8, D9: Remove the paint from the winch and the bevel gear case at the locations where they will be in contact. Install seal (5) on shaft (6). Install shaft (6), pin (7), and ring (8).



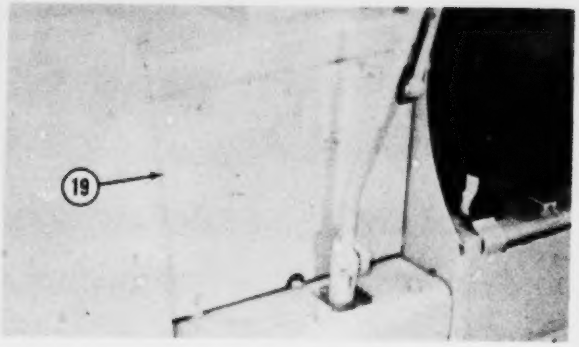
❸ D8, D9: Install coupling (9), pin (10), and ring (11). Install seal (12). Remove screen and cover assembly (13).



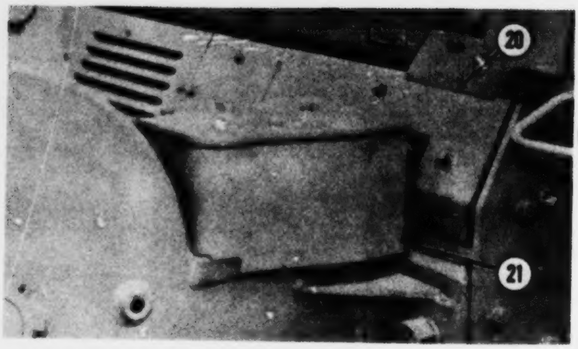
❹ D8, D9: Move winch (14) into position on the studs. At the same time, engage the drive coupling with the transmission shaft. Install washers and nuts (15) on the outer studs. Tighten the large nuts to 1800 ± 180 lb. ft. (249 ± 25). Tighten the smaller nuts to 1200 ± 150 lb. ft. (166 ± 21).



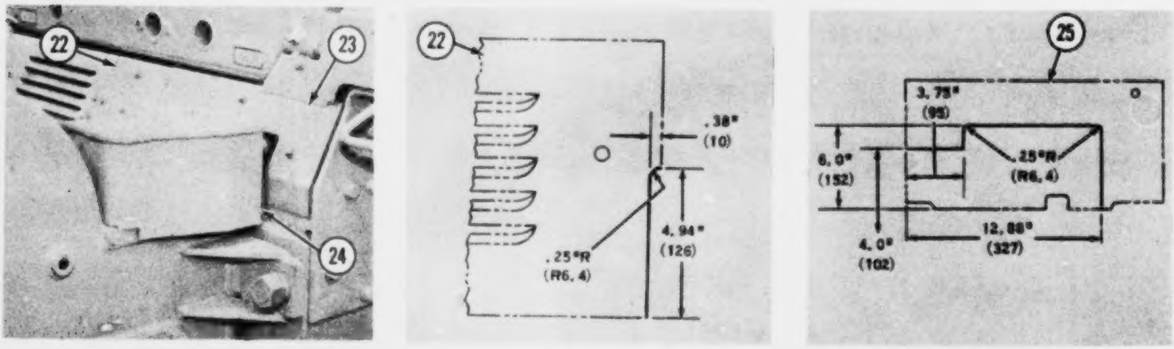
❺ D8, D9: Install washers and locknuts (16) on the inner studs. Tighten locknuts (16) using a 2P2344 Wrench. Install the screen and cover assembly (13). Be sure the O-ring seal is in the bottom of the screen. Connect oil lines (17) and (18).



⑥ D8, D9: After the adjustment has been made to the control cables, install plate (19).

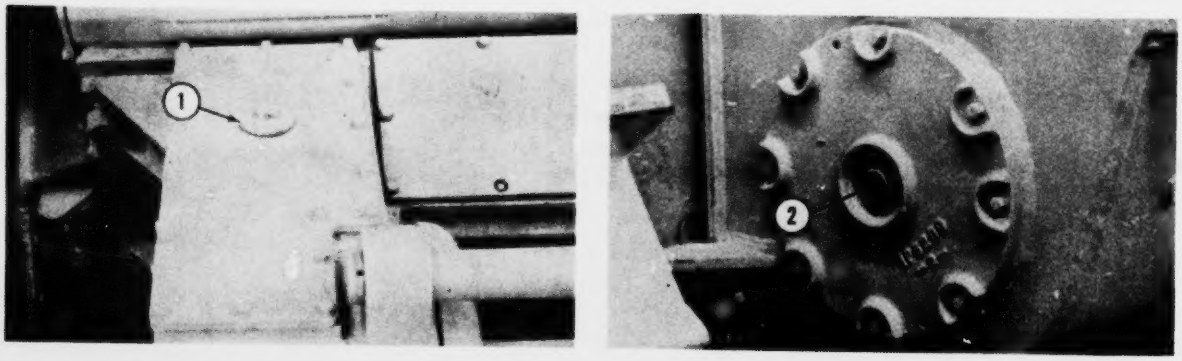


⑦ D8: Install new plate (20) and cover (21). Do not install plate (20) with ROPS.


22
23
24
22
.38"
(10)
4.94"
(126)
.25"R
(R6.4)
25
3.75"
(95)
6.0"
(152)
.25"R
(R6.4)
4.0"
(102)
12.88"
(327)

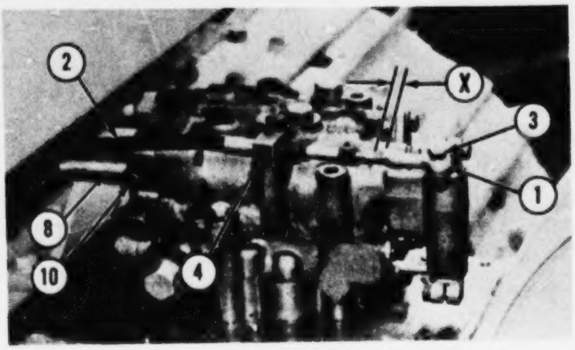
⑧ Standard D9: Cut center door (22) as shown. Install new door (23) and cover (24). D9 with ROPS: Cut right door (25) as shown and install cover (24).

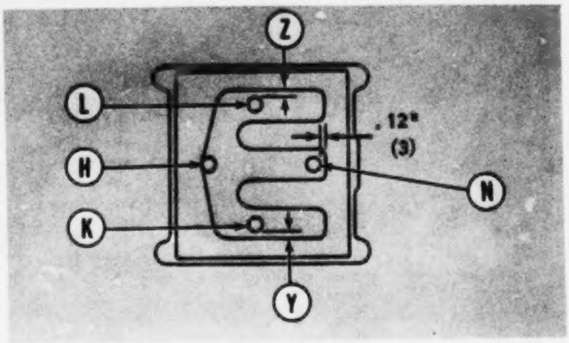
D8, D9: INSTALLING OIL

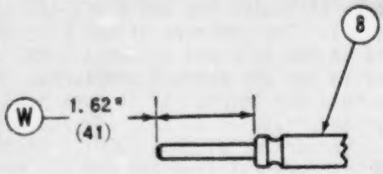


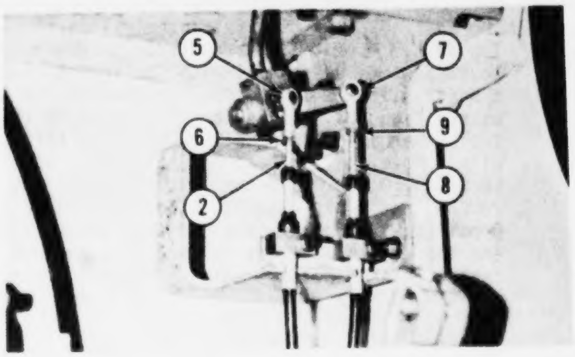
① Remove oil fill plug (1). Put the same oil in the winch that is used in the tractor engine. Put oil in the winch until it can be seen in window (2). Start the engine and run it at low idle. Add oil until it can be seen in window (2).

CABLE CONTROL ADJUSTMENT







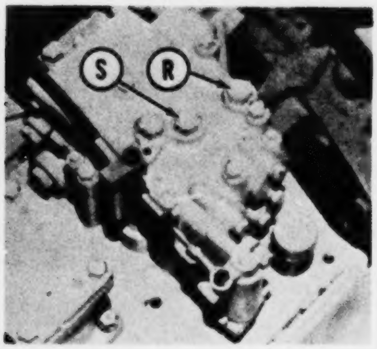


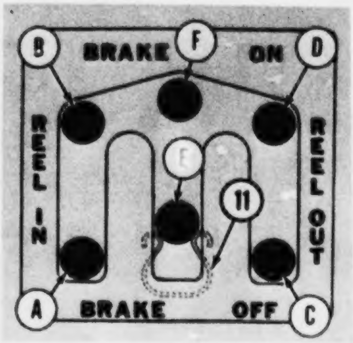
1. Install end (1) on cable (2) and make an adjustment so that dimension (X) is .50" (12.7). Install bolt and locknut (3). Install clamp (4).

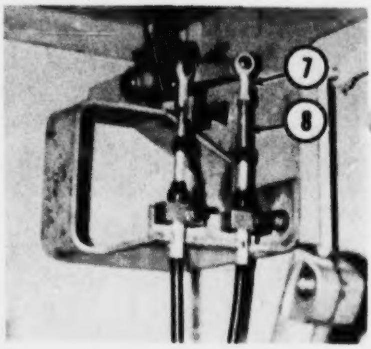
2. (H), (K), (L), and (N) are control lever positions. Put the control lever in position (H). Install cable end (5) on cable (2). Make an adjustment to end (5) so that dimensions (Y) and (Z) are the same when the lever is in position (K) and (L). Tighten locknut (6).

3. Put the control lever in position (N). Install end (7) on cable (8). Turn cable (8) in or out until dimension (W) is 1.62" ± 03" (41.1 ± 0.7). Tighten locknut (9).

4. Put the control lever in position (H). Install cable (8) in the control valve. Install and tighten bolt (10).

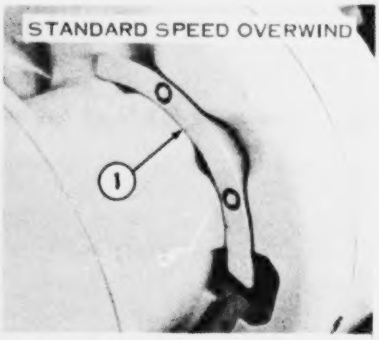


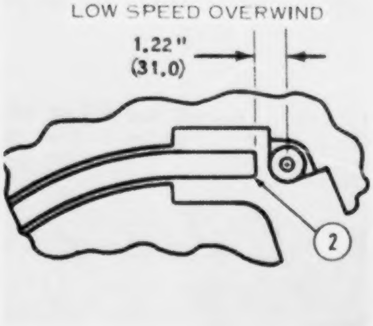


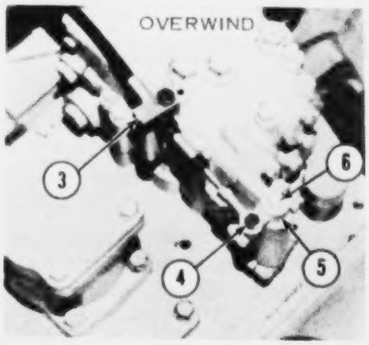


5 Remove the plugs from input clutch pressure tap (R) and directional clutch pressure tap (S). Install a 0 - 600 psi (0.0 - 42.19) oil pressure gauge in each tap. Run the engine at high idle with the winch in the BRAKE OFF position until the oil in the winch is at operating temperature. Lower engine speed to low idle. Move the control lever to position (F), then move it toward the BRAKE OFF position until the lever just makes contact with the spring clip at position (E). The pressure at tap (S) should be 185 ± 5 psi (13.01 ± 0.35), and the pressure at tap (R) should be 300 ± 15 psi (21.09 ± 1.05) with the lever at position (E). Adjust end (7) on cable (8) as necessary to get the correct pressures. Pull the control lever into spring clip (11). The clip should firmly hold the lever. If it does not, adjust the clip. Move the lever to position (F). In this position, the pressures at taps (R) and (S) should both be 0 psi (0.0). Move the lever to positions (B) and (D). On earlier winches (32U1 - 32U252, 33U1 - 33U289, and 34U1 - 34U193) with check valve controls, the pressures at taps (R) and (S) should both be 0 psi (0.0). On later winches with sequence valve controls, the pressure at tap (R) should be 0 psi (0.0), and the pressure at tap (S) may be a maximum of 60 psi (4.22). Make further adjustments to end (7) on cable (8) as necessary until all pressures are correct.

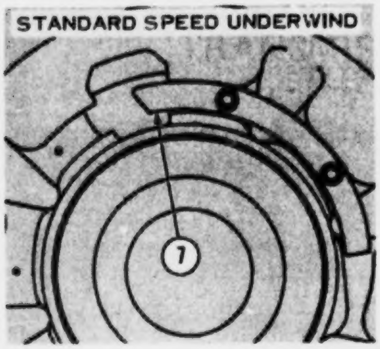
CHANGING TO CABLE UNDERWIND - D8, D9

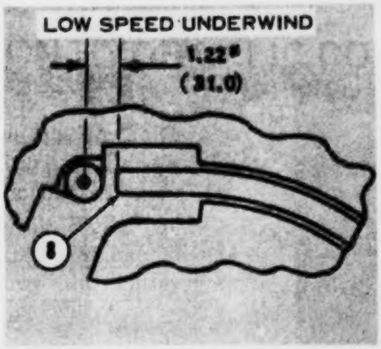


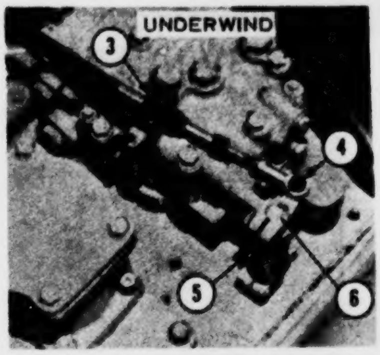




1 All winches are shipped from the factory for overwind operation as shown. To change to cable underwind, remove clamp (1) or strip (2) from the winch drum. Remove clamp (3), bolt (4), and lever (5). Remove the key from shaft (6).

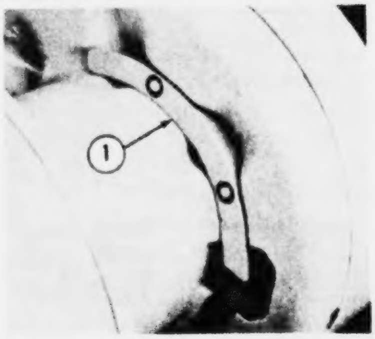

STANDARD SPEED UNDERWIND
7

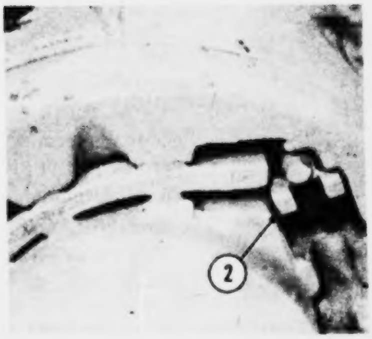

LOW SPEED UNDERWIND
1.22"
(31.0)
8

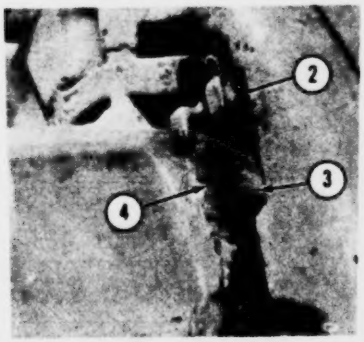

UNDERWIND
3
4
5
6

② Install 2P3567 Clamp (7) as shown in a standard speed winch. Install 2P9151 Strip (8) in a low speed winch as shown. Weld strip (8) with .19" (4.8) penetrating flare-V-groove welds, .50" (12.7) long, 4.0" (103) apart. Install the key in the opposite side of shaft (6). Install lever (5), bolt (4) and clamp (3) as shown.

INSTALLING CABLE

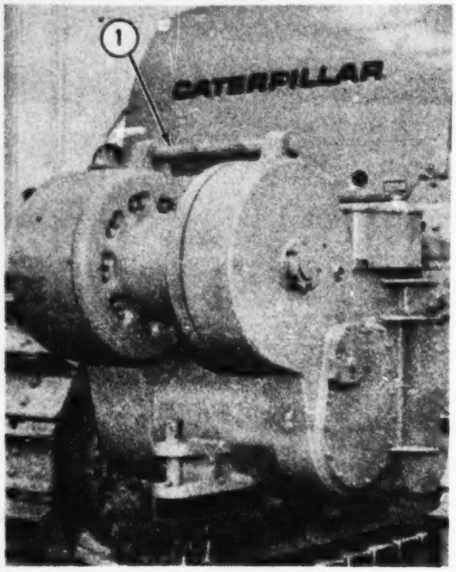


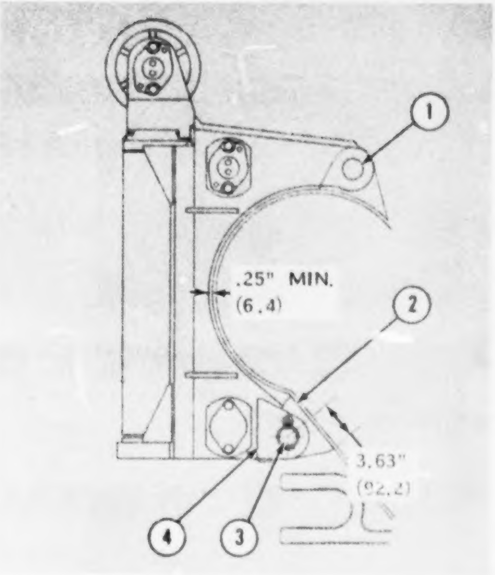




① Put the cable in a straight line behind the tractor. Remove clamp (1) or (2). Install cable end (3) in groove (4). Install clamp (1) or (2).

INSTALLING FAIRLEAD





❶ Remove pin (1). Put the fairlead group on the winch as shown. Install pin (1). Install supports (2) with the longer part of the support as shown. Install pins (3). Move each support to the center of bracket (4). Weld supports (2) to the winch. Use .10" (2.54) butt welds followed by .38" (9.7) fillet welds, all around.

GEG02142-02

OPERATION & MAINTENANCE GUIDE

55, 56, 57, 58 & 59 TOWING WINCHES

SERIAL NUMBERS

29U1-UP
30U1-UP
31U1-UP
32U1-UP
33U1-UP
34U1-UP
35U1-UP
36U1-UP
37U1-UP

This information supplements the information in the Operators Guide and the Lubrication and Maintenance Guide for the tractor.

FOREWORD

This book is a guide to equipment care. The illustrated, step-by-step instructions are grouped by servicing intervals; items without specific intervals are listed under "When Required". Circled numbers in the Lubrication and Maintenance Chart are to key the charted items to the instructions in the book.

Use the service meter to determine servicing intervals. Calendar intervals (daily, weekly, 2 weeks, etc.) shown may be used instead of service meter intervals if it provides more convenient servicing schedules; and approximates the indicated service meter reading.

Perform previous interval items at multiples of the original requirement. For example, at 100 service hours or 2 weeks, also perform those items listed under "Every 50 Service Hours or Weekly" and "Every 10 Service Hours or Daily".

Some photographs in this publication may show details or attachments that may be different from your unit.

Continuing improvement and advancement of product design may cause changes to your machine which may not be included in this publication. Each publication is reviewed and revised, as required, to update and include these changes in later editions.

Whenever a question arises regarding your Caterpillar product, or this publication, please consult your Caterpillar dealer for the latest available information.

SAFETY

⚠ **THIS SYMBOL WARNS OF POSSIBLE PERSONAL INJURY OR PROPERTY DAMAGE.**

Lower or block equipment and stop engine before servicing.

Lower all equipment and set parking brake before leaving machine.

Report needed repairs.

Make certain all safety guards and covers are in place and secured.

Clear personnel from machine and area.

Keep operator's compartment clean.

Move all controls to HOLD or NEUTRAL before starting engine.

Check all controls for freedom from binding before starting.

Test controls in a safe area before operating.

Know the hand signals and who gives them.

Clear obstacles from path of machine — note hazards such as wires and ditches.

Be particularly careful on machines you do not usually operate.

Lower all equipment and stop engine before leaving machine.

Look behind machine before backing.

Stay clear of overhangs, electric wires, slide areas or other danger areas.

Match speed with job conditions.

Never straddle cable.

Never leave tractor when cable is tight.

Stay safe distance from edge of cliff or overhang.

Keep machine under control — do not try to work winch over capacity.

Report needed repairs noted during operation.

Lower all equipment and move controls to release pressure before servicing winch.

Do not attempt adjustments while tractor is moving or the engine running.

Wear gloves when handling cable.

Use the proper tools. Change or repair broken or damaged equipment.

Wear safety glasses and shoes as the job requires.

Do not allow unauthorized personnel on tractor when it is being serviced.

Promote good housekeeping. Keep tools and work area clean.

Do not attempt repairs you do not understand.

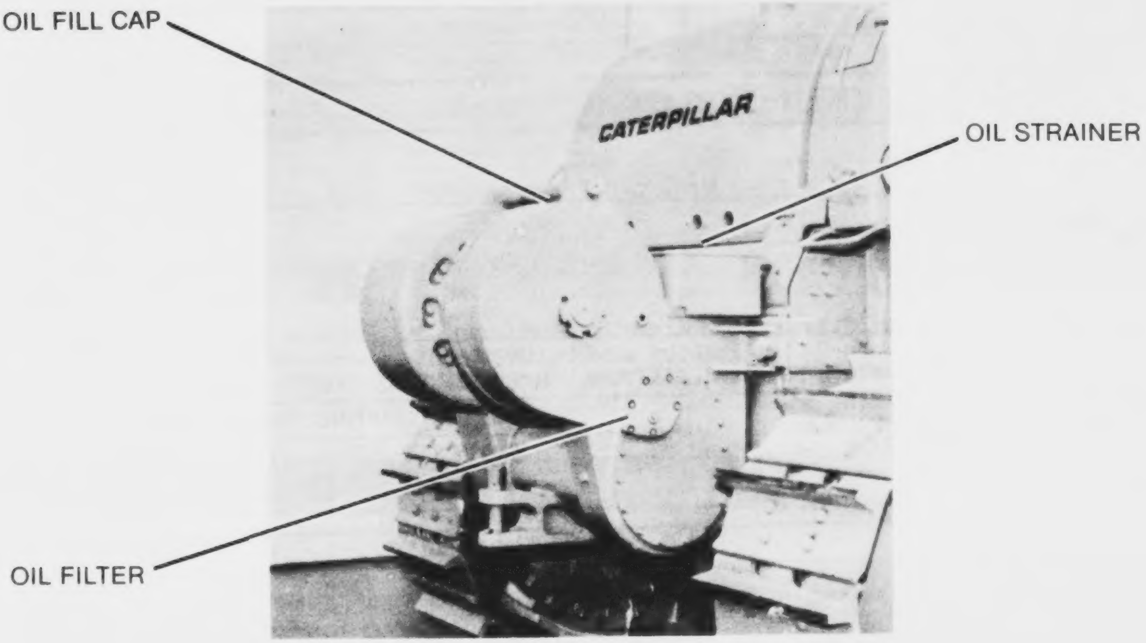
Attach tags to controls while winch is being serviced.

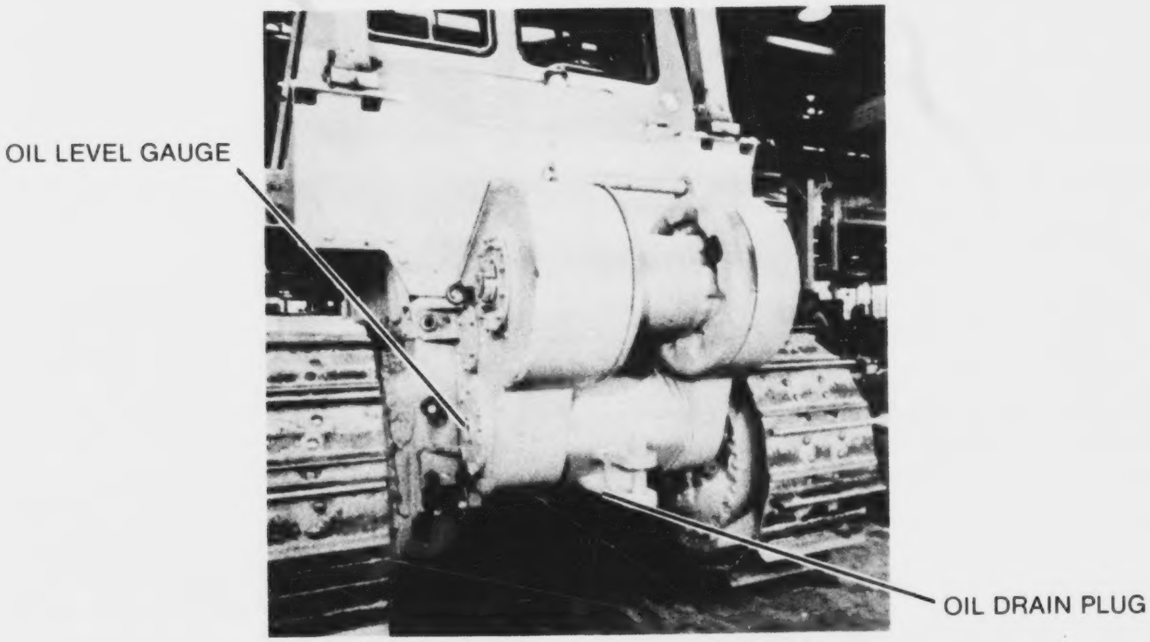
Read warning and caution information provided on the winch. Follow servicing instructions carefully.

Use proper cable and keep it taut, do not jerk load.

Make sure cable is slack before servicing winch.

Do not use cable if it is kinked or frayed.


OIL FILL CAP
CATERPILLAR
OIL STRAINER
OIL FILTER


OIL LEVEL GAUGE
OIL DRAIN PLUG

LUBRICATION AND MAINTENANCE CHART

ITEM	SERVICE	LUBRICANT	MAINTENANCE	PAGE NO.
EVERY 500 SERVICE HOURS OR 3 MONTHS				
① Magnetic strainer	Clean strainer		●	5
② Filter	Change element		●	5
EVERY 1000 SERVICE HOURS OR 6 MONTHS				
③ Breather	Change breather		●	5
④ Oil sump(1)	Change lubricant	CD	●	5

(1)Check frequently if any signs of leakage develop or are suspected.

Key to Lubricant:
CD - Engine Service Classification **CD**, or MIL-L-2104C

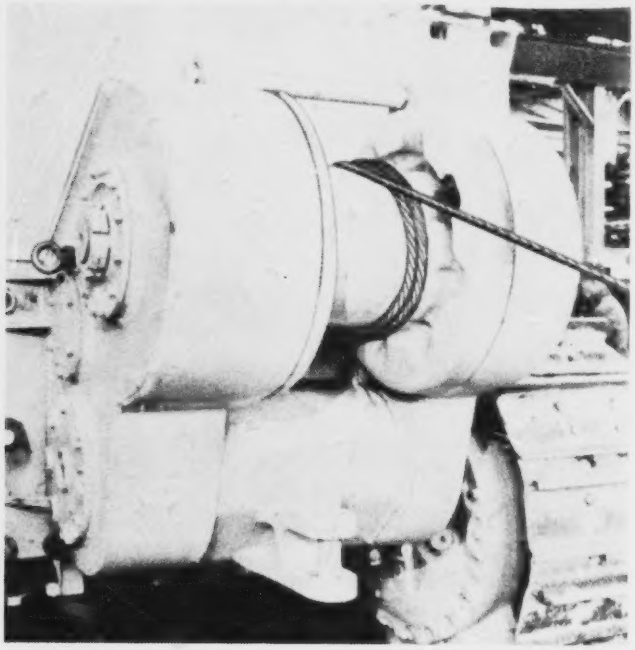
RECOMMENDED LUBRICANTS AT STARTING TEMPERATURES FROM −10°F (−23°C) TO +120°F (+48°C)(1)		
COMPARTMENT OR SYSTEM	STARTING TEMPERATURES	
	ABOVE 32°F (0°C)	BELOW 32°F (0°C)
	CD	
Winch Oil Sump(2)	SAE 30	SAE 10W

(1)Below −10°F (−23°C) consult your Caterpillar dealer for Cold Weather Recommendations.

(2)Use same type of oil as used in engine.

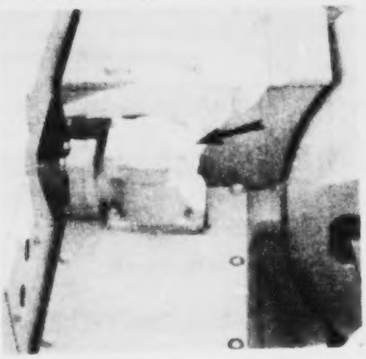
Key to Lubricant:
CD - Engine Service Classification **CD**, or MIL-L-2104C

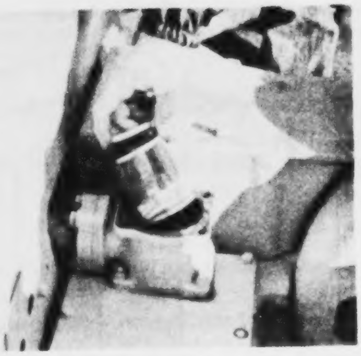
Check cable for worn or frayed spots. Check oil level. With engine running at low idle, oil must be visible in sight gauge. Check for leaks and damaged or worn parts.



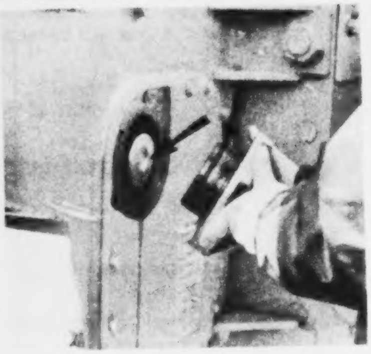
EVERY 500 SERVICE HOURS OR 3 MONTHS

① MAGNETIC STRAINER


1. Remove cover and strainer. Wash strainer in clean solvent.


2. Install strainer. Inspect seal. Install a new seal if necessary. Install cover.

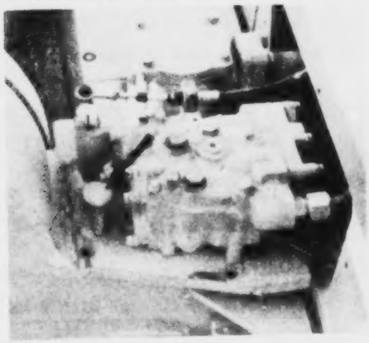
② FILTER


1. Remove cover and filter element. Install new element.

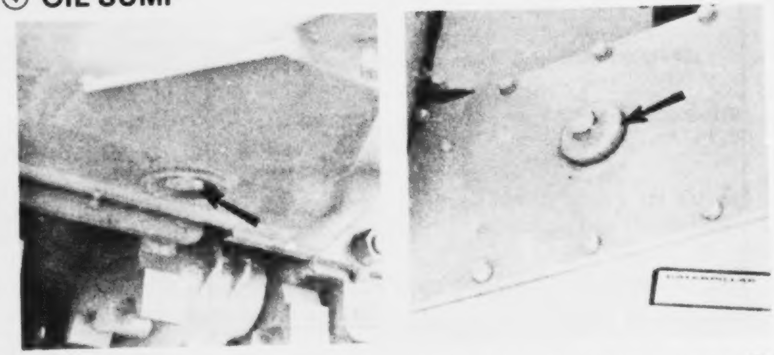
2. Inspect seal. Install a new seal if necessary. Install cover.

EVERY 1000 SERVICE HOURS OR 6 MONTHS

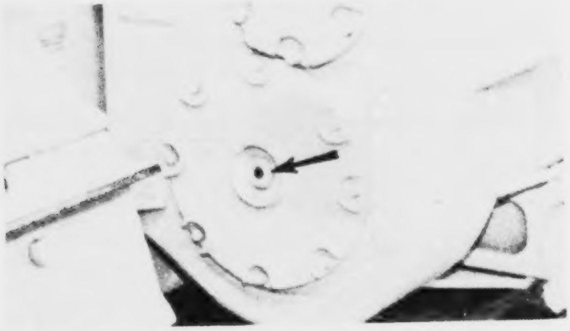
③ BREATHER


Remove and discard breather. Install a new breather.

④ OIL SUMP

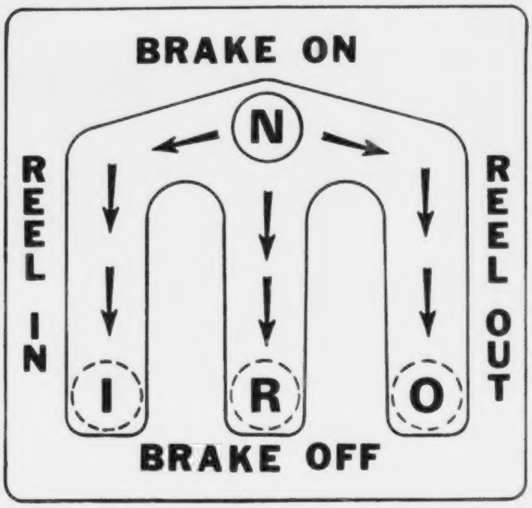

1. Remove drain and fill plugs. Allow oil to drain. Do items ① and ②.

2. Clean and install drain plug.


3. Fill compartment until oil is visible in the sight gauge. Clean and install fill plug. See REFILL CAPACITIES.

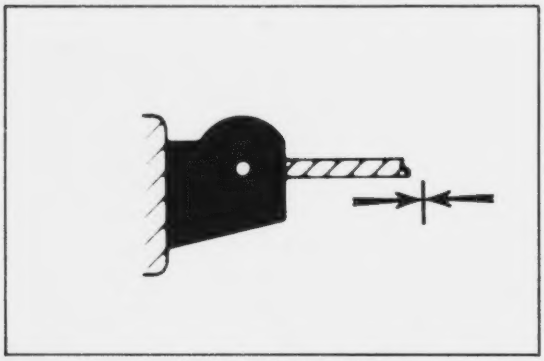
4. Start engine and operate at low idle. Check oil level with engine running at low idle. Oil level must be visible in sight gauge.

OPERATION


BRAKE ON
N
REEL IN
REEL OUT
I
R
O
BRAKE OFF

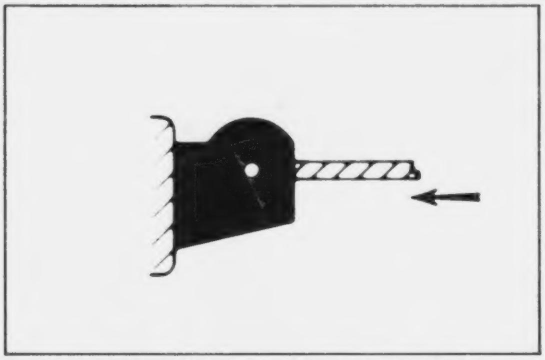
LEVER POSITIONS

Ⓝ BRAKE ON (NEUTRAL)



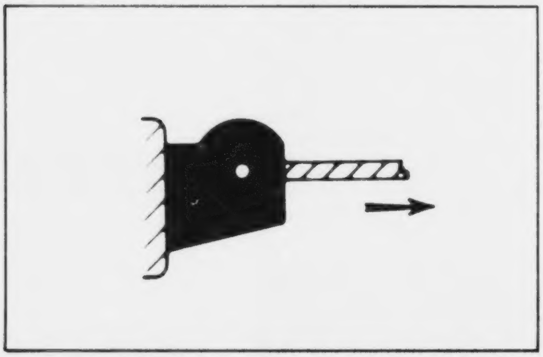
Cable Will Not Move.

Ⓘ REEL IN



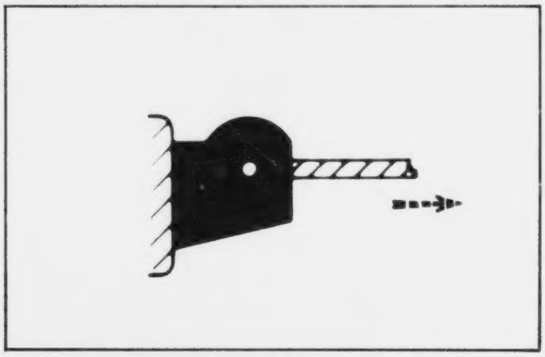
Cable Will Move Toward The Winch.

Ⓞ REEL OUT



Cable Will Move Away From The Winch.

Ⓡ BRAKE OFF (RELEASE)



Cable Will Move Out Under Load.

NORMAL OPERATION

CAUTION

Always winch with cable in a straight line behind tractor. Shifting winch at full engine speeds is possible. However, for safety and maximum service life of winch components, engine decelerating is recommended. Control line speed, after shifting, by varying engine speed.

BRAKE ON (NEUTRAL) Ⓝ — For towing, holding loads or when winch is not in use.

REEL IN or REEL OUT Ⓘ or Ⓞ — To haul in or lower loads. Use flywheel clutch and/or decelerate to reel in slowly.

NOTE

Engine or torque converter may stall if line load and/or engine load is too high when engaged.

BRAKE OFF (RELEASE) Ⓡ — To move tractor away from loads, or to lower load by its own weight. In most applications, sufficient line tension will be maintained with the lever fully engaged. However, holding a load on a slope, with the tractor moving forward, may require some braking action. Brake only as much as necessary to maintain minimum line tension required.

CAUTION

Do not leave in BRAKE OFF for extended periods. When moving away from a load, operate tractor in low gears to prevent overspeeding of winch components.

INCHING (FINE CONTROL OPERATION)

CAUTION

Inch loads with engine speed low and tractor stationary. Do not operate for extended periods of time while INCHING.

INCHING OUT — Move lever slowly towards BRAKE OFF position until load starts to move. For precise lowering, move lever slightly to engaged or disengaged position as required.

INCHING IN — Direct Drive only — Disengage flywheel clutch. Position lever in the REEL IN slot so load will move when flywheel clutch is slowly engaged. Adjust engine speed as necessary to move load.

INCHING IN — Power Shift only — Move lever slowly towards the fully engaged REEL IN position until load starts to move. Increase engine speed if necessary to raise load.

⚠ WARNING

Exercise care with suspended loads; if engine speed is too low the weight of the load may cause it to drop, even though the winch is in the REEL IN position.

INCHING OUT: When Load Is Not Heavy Enough To Lower Itself In The BRAKE OFF Position.

Direct Drive — Disengage flywheel clutch. Position lever in the REEL OUT slot so load will move when flywheel clutch is slowly engaged.

Power Shift — Move the lever slowly towards the fully engaged REEL OUT position until load starts to move.

INSTALLING CABLE

NOTE

Cable overwind is standard. To change to underwind, modifications must be made to the Winch and controls. To reverse the direction of drum rotation, contact your Caterpillar dealer for the necessary parts and information to modify the drum and control.

⚠ WARNING

Do not underwind cable onto winch drum unless the winch has been modified to operate in this manner.

Cable is attached to the drum on all Cat winches with a standard cable ferrule. The ferrule, leaded or wedged to the cable, is fitted into a socket on the drum and secured with a bolt-down clamp.

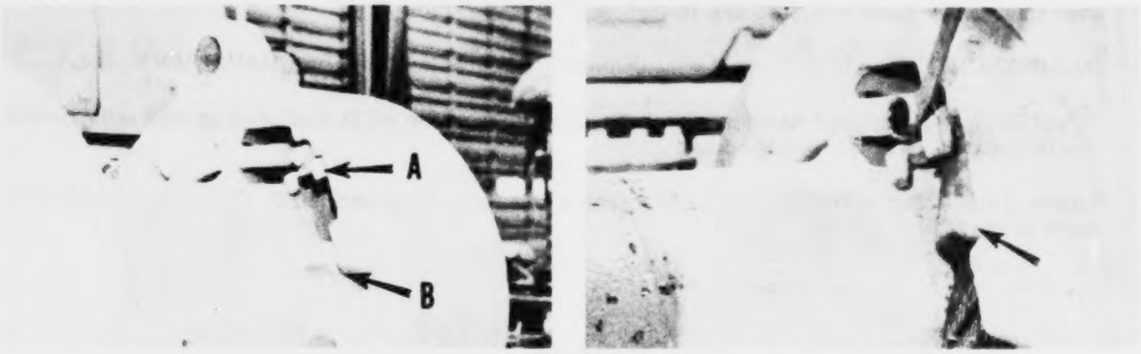
Ferrules are made in various diameters and lengths. When ordering cable from your local supplier, use the following guide to specify the correct ferrule.

		CABLE FERRULES in. (mm)			DRUM CAPACITY ft. (m)	
WINCH	CABLE DIAMETER	NUMBER	OUTSIDE DIAMETER	LENGTH	LOW SPEED	STANDARD
55/56	¾ (19)*	L- 6	2⅛ (54)	2⅝ (66)	375 (114)	333 (101)
	⅞ (22)	L- 7	2⅛ (54)	2⅝ (66)	270 (82)	240 (73)
	1 (25)	L- 8	2⅛ (54)	2⅝ (66)	210 (64)	186 (57)
57	⅞ (22)	J- 7	2⅜ (60)	2¾ (69)	326 (99)	299 (91)
	1 (25)*	J- 8	2⅜ (60)	2¾ (69)	253 (77)	232 (71)
	1⅛ (28)	J- 9	2⅜ (60)	2¾ (69)	202 (62)	185 (56)
58/59	1⅛ (28)*	J- 9	2⅜ (60)	2¾ (69)	266 (81)	225 (69)
	1¼ (32)	J-10	2⅜ (60)	2¾ (69)	212 (65)	178 (54)

***Standard cable diameter.**

NOTE

If cable diameter is increased from the standard diameter it should be done for extended cable life only. It is not to be used for increasing winch capacity.

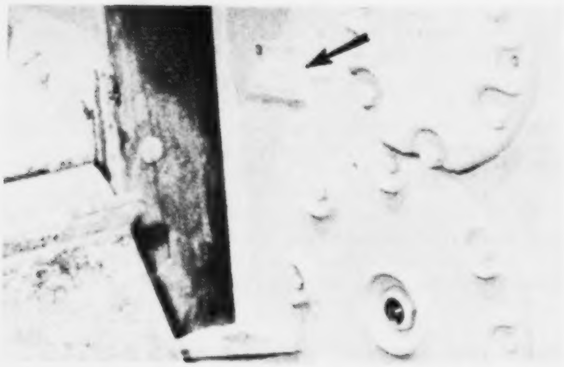


Put the cable in a straight line behind the tractor. Remove clamp (A). Install cable end into groove (B). Install clamp (A).

REFILL CAPACITIES (Approximate)

MODEL	U.S. MEASURE	METRIC MEASURE	IMPERIAL MEASURE
55	11.5 gal.	44,3 litre	9.6 gal.
56	11.5 gal.	44,3 litre	9.6 gal.
57	16.0 gal.	61,0 litre	13.3 gal.
58	17 gal.	64,4 litre	14.2 gal.
59	17 gal.	64,4 litre	14.2 gal.

SERIAL NUMBER LOCATIONS



CATERPILLAR

SPECIAL INSTRUCTION

INSTALLING 8D RIPPER (47D, 53F, 54F, 92M, 93M, 97S)

MONTAGE DU RIPPER 8D (47D, 53F, 54F, 92M, 93M, 97S)

EINBAU DES AUFREISSERS 8D (47D, 53F, 54F, 92M, 93M, 97S)

INSTALACION DEL DESGARRADOR 8D (47D, 53F, 54F, 92M, 93M, 97S)

5350
6312

D8K 66V, 76V, 77V

Dimensions in inches (mm) - Cotes en pouces (mm) - Abmessungen in Zoll (mm) - Dimensiones en pulgadas (mm)
Torques in lb-ft (mkg) (Nm) - Serrages en pieds-livres (mkg) (Nm)
Anzugsmomente in lb-ft (mkg) (Nm) - Par de apriete en lb-pie (mkg) (Nm)

Ø = Diameter - Diamètre - Durchmesser - Diámetro

The 8D Ripper is available with two hydraulic cylinders or with two solid links, which are used to adjust the ripper tooth pitch. The 8D Ripper is also available with single or multiple ripper teeth. See Special Instruction Form GEG02268 for installation of the 183 Hydraulic Control, valves, lines and control linkage.

Le Ripper 8D existe en deux versions : l'une où l'angle d'attaque des dents se règle par deux vérins hydrauliques, l'autre, à angle fixe, où des bielles rigides remplacent les vérins. Le Ripper 8D peut être fourni en modèle à une dent ou en modèle multidents. Voir l'instruction spéciale GEG02268 pour le montage de la Commande hydráulique 183 et des canalisations, distributeur et tringlerie.

Der Aufreißer 8D ist mit zwei Hydraulikzylindern oder zwei Starrgliedern zur Reißwinkelverstellung erhältlich. Der Aufreißer 8D ist auch als Einzel- oder Mehrzahnaufreißer erhältlich. Der Einbau der Hydraulikanlage 183 mit Ventilen, Leitungen und Steuergestänge ist in der Special Instruction Form GEG02268 (derzeitig nur in englischer Sprache) beschrieben.

El Desgarrador 8D se suministra con dos cilindros hidráulicos o con dos varillas sólidas, que se usan para ajustar la inclinación del diente del desgarrador. El Desgarrador 8D se suministra también con un solo diente o con varios dientes. Ver Instrucciones especiales GEG02268 para instalación del Control hidráulico 183, válvulas, tuberías y varillaje de control.

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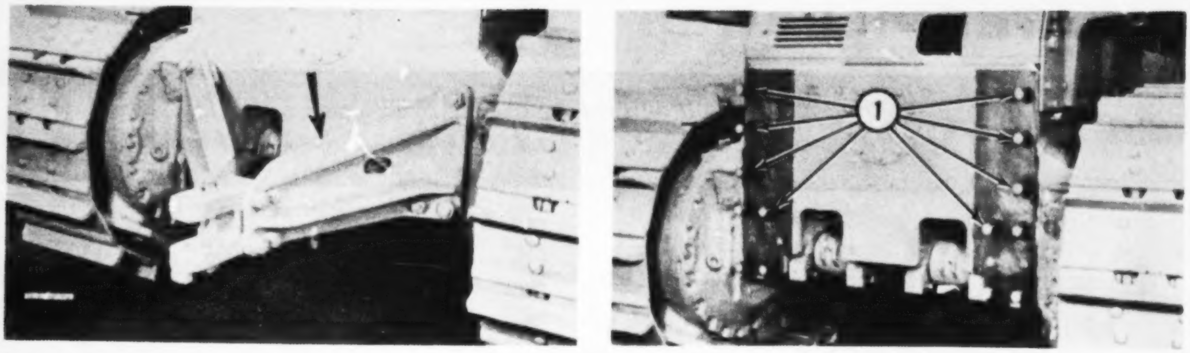
CATERPILLAR FUNDAMENTAL ENGLISH

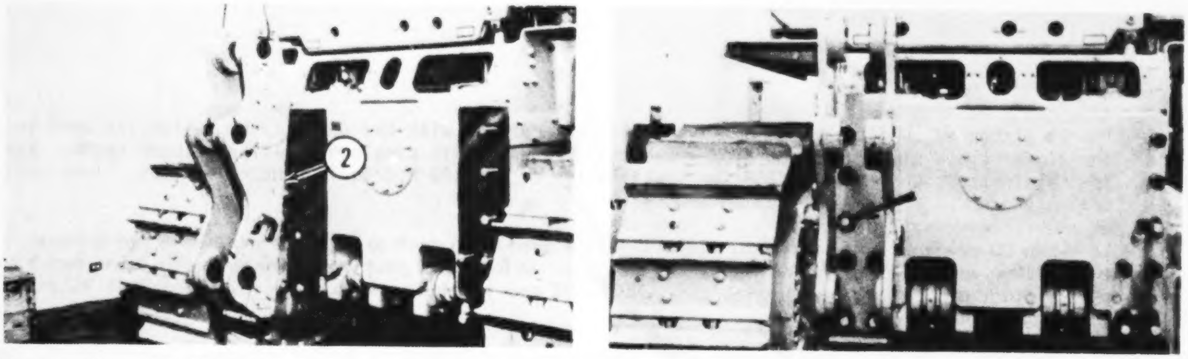


① Remove the drawbar, corks and all paint from the mounting area on the bevel gear case. Install eight studs (1) and tighten to a torque of 550 ± 50 lb. ft. (76.1 ± 6.9).

Déposer la barre d'attelage; enlever les bouchons de liège et toute peinture de la face de montage sur le bâti arrière du tracteur. Visser les huit goujons (1) et les serrer à 550 ± 50 pieds-livres (76,1 ± 6,9).

Zughaken und Korken ausbauen und Anbaustelle am Tellerradgehäuse gründlich von Farbresten säubern. Acht Stehbolzen (1) einbauen und auf 550 ± 50 lb-ft (76,1 ± 6,9) anziehen.

Remueva la barra de tiro, los corchos y toda la pintura del área de montaje en la caja de la corona. Instale ocho prisioneros (1) y apriételos a un par de 550 ± 50 lb-pie (76,1 ± 6,9).

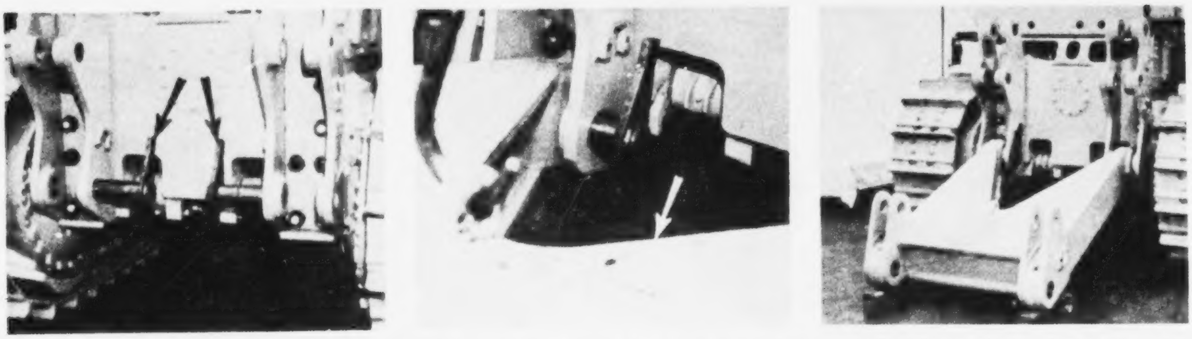


② Remove all paint from the mounting surface of the support brackets and around the spotfaces; install support brackets (2). Put lubricant on the stud threads and install the washers and nuts. Tighten the nuts to a torque of 1800 ± 180 lb. ft. (249 ± 24.9).

Enlever toute la peinture de la portée de montage des supports et autour des lamages; monter les supports (2). Enduire les filets des goujons avec du lubrifiant et monter les rondelles et écrous. Serrer ceux-ci à 1800 ± 180 pieds-livres (249 ± 24,9).

Alle Farbreste von der Anbaufläche der Stützbügel und um die Auflagefläche gründlich entfernen; Bügel (2) einbauen, Stehbolzengewinde mit Schmiermittel bestreichen und Beilagen und Muttern einbauen. Muttern 1800 ± 180 lb-ft (249 ± 24,9) anziehen.

Remueva toda la pintura de la superficie de montaje de las abrazaderas de soporte y alrededor de los refrentados. Instale abrazaderas de soporte (2). Coloque lubricante en las roscas de los prisioneros e instale las arandelas y tuercas. Apriete las tuercas a un par de 1800 ± 180 lb-pie (249 ± 24,9).

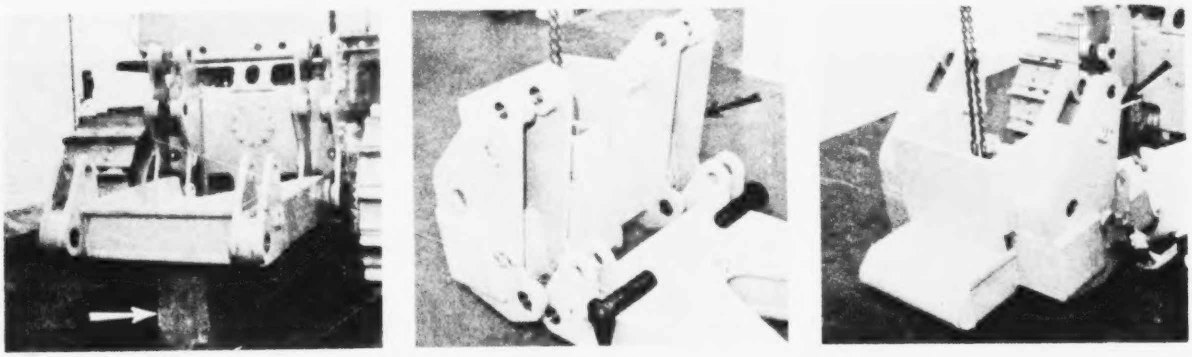


③ Install eight 4J8981 Seals in the ripper frame. Install the ripper frame using washers as necessary. Install the grease fittings.

Placer les huit bagues d'étanchéité 4J8981 dans le bâti du ripper. Monter le bâti du ripper en utilisant le nombre de rondelles nécessaire. Monter les graisseurs.

Acht Dichtungen 4J8981 in den Aufreißerrahmen einbauen. Aufreißerrahmen mit den benötigten Beilagen einbauen. Schmiernippel einbauen.

Instale ocho Sellos 4J8981 en el bastidor del desgarrador. Instale el bastidor del desgarrador usando arandelas en la forma necesaria. Instale las graseras.

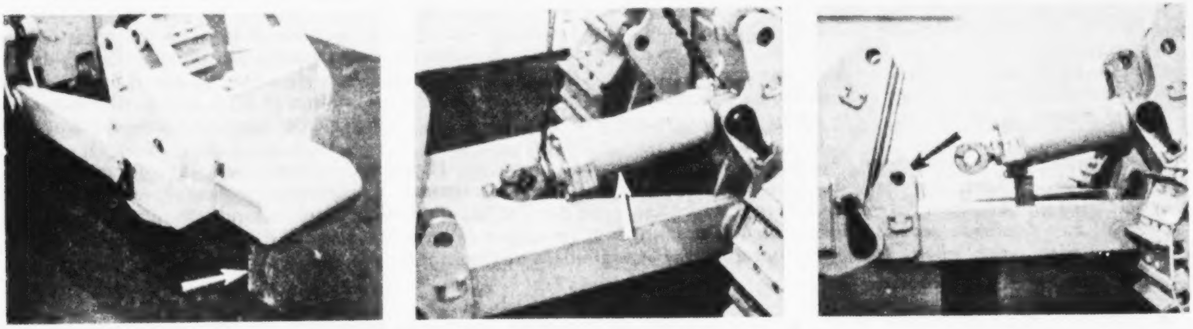


④ Put a block under the frame and install the beam assembly.

Placer une grosse cale sous le bâti du ripper et monter le porte-dent.

Rahmen unterbauen und Träger am Rahmen anbauen.

Coloque un bloque debajo del bastidor e instale la viga.

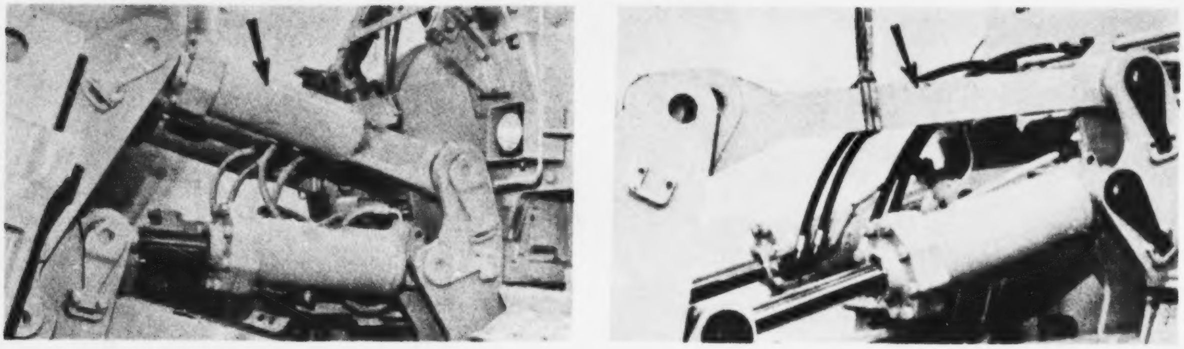


⑤ Put a block under the beam assembly and install the lift cylinders.

Placer une grosse cale sous le porte-dent et monter les vérins de levage.

Träger unterbauen und Aufreißerzylinder einbauen.

Coloque un bloque debajo de la viga e instale los cilindros de levantamiento.

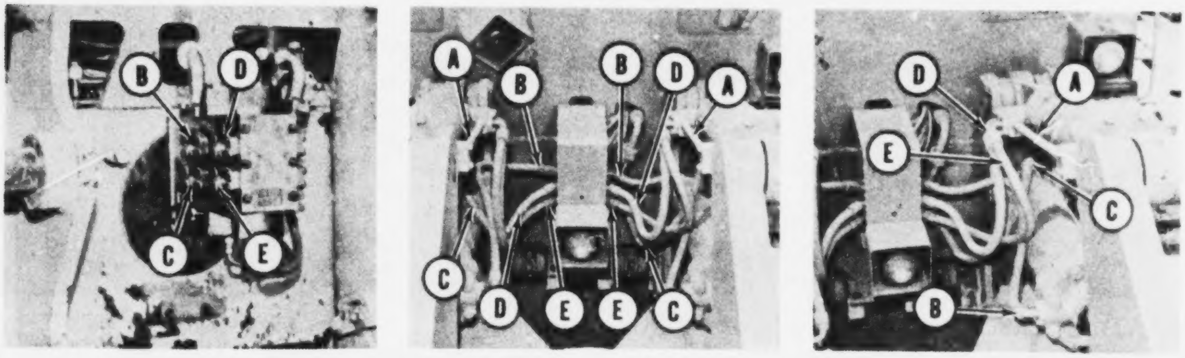


⑥ Install the pitch cylinders or solid links if so equipped.

Monter les vérins d'inclinaison de dent ou les bielles rigides suivant le cas.

Reißwinkelzylinder oder Starrglieder, falls so ausgerüstet, einbauen.

Instale los cilindros de inclinación o las varillas sólidas si va a estar equipado con éstas.

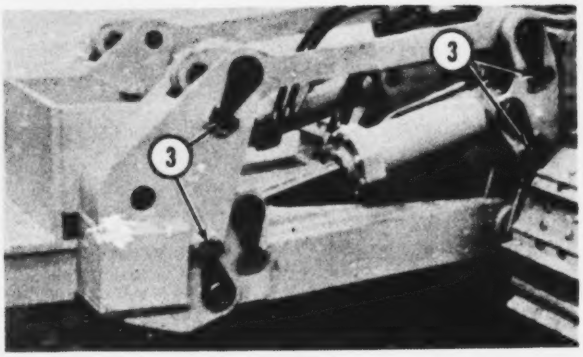


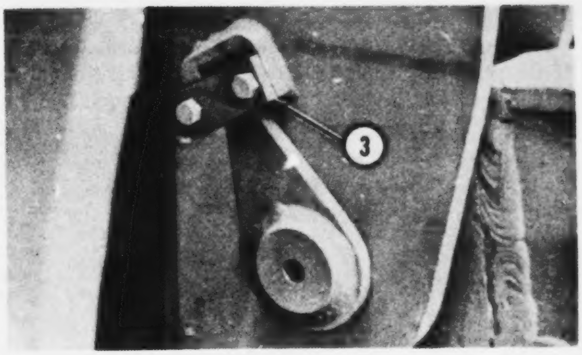
⑦ Install tube assemblies (A) using seals, lockwashers and bolts. Install the hydraulic lines as shown using seals, flanges, washers and bolts. Connect lines (B) from the control valve to the lift cylinder rod end; lines (C) from the control valve to the lift cylinder head end; lines (D) from the control valve to pitch cylinder head end; and lines (E) from the control valve to the pitch cylinder rod end. If the ripper is equipped with solid links, hydraulic lines (D) and (E) are not needed.

Monter les tubulures (A) en utilisant les joints, rondelles Grower et vis. Monter les canalisations hydrauliques comme représenté en utilisant les joints, brides, rondelles et vis prévus. Brancher les canalisations (B) allant du distributeur au côté tige de piston des vérins de relevage et (C) allant du distributeur au côté tête de piston de ces vérins; brancher les canalisations (D) allant du distributeur au côté tête de piston des vérins d'inclinaison et (E) allant du distributeur au côté opposé de ces vérins. Si le ripper est du type à bielles rigides, il n'y a pas à monter les canalisations (D) et (E).

Leitungen (A) mit Dichtungen, Federscheiben und Schrauben einbauen. Hydraulikleitungen, wie gezeigt, mit Dichtungen, Flanschen, Beilagen und Schrauben einbauen. Leitungen (B) vom Steuerventil zum Stangenende des Aufreißerzylinders anschließen; Leitungen (C) vom Steuerventil zum Kopfende des Aufreißerzylinders anschließen; Leitungen (D) vom Steuerventil zum Kopfende des Reißwinkelzylinders anschließen; Leitungen (E) vom Steuerventil zum Stangenende des Reißwinkelzylinders anschließen. Wenn der Aufreißer mit Starrgliedern ausgerüstet ist, werden die Hydraulikleitungen (D) und (E) nicht verwendet.

Instale los tubos (A) usando sellos, arandelas de presión y pernos. Instale las tuberías hidráulicas como se muestra usando sellos, bridas, arandelas y pernos. Conecte las tuberías (B) desde la válvula de control al extremo de la varilla del cilindro de levantamiento; las tuberías (C) desde la válvula de control al extremo de la cabeza del cilindro de levantamiento; las tuberías (D) de la válvula de control al extremo de la cabeza del cilindro de inclinación; y las tuberías (E) desde la válvula de control al extremo de la varilla del cilindro de inclinación. Si el desgarrador está equipado con varillas sólidas, las tuberías hidráulicas (D) y (E) no son necesarias.



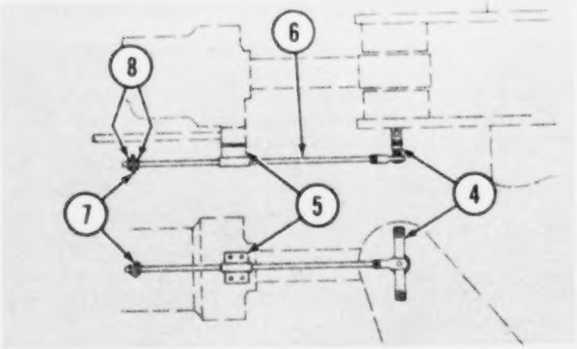


8 Connect the hydraulic cylinders or solid links. Install all pins, plates (3), lockwires and grease fittings.

Accoupler les vérins hydrauliques ou les bielles rigides. Monter tous les axes, arrêtoirs (3), fils de freinage et les graisseurs.

Hydraulikzylinder oder Starrglieder anschließen. Alle Bolzen, Beilagen (3), Sicherungsdrähte und Schmiernippel einbauen.

Conecte los cilindros hidráulicos o las varillas sólidas. Instale todos los pasadores, planchas (3), alambres de traba y graseras.

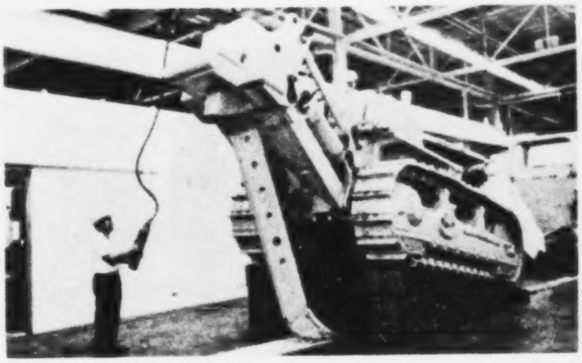


9 Install the indicator between the upper right hydraulic cylinder and the ripper beam. Install brackets (4) and (5), and rod (6). Install washer (7) on rod (6) using two nuts (8).

Monter la tringle indicatrice d'inclinaison entre le vérin supérieur de droite et le porte-dent du ripper. Monter les supports (4) et (5) et la tringle (6). Mettre une rondelle (7) sur la tringle (6) à l'aide des deux écrous (8).

Anzeiger zwischen dem rechten oberen Hydraulikzylinder und dem Aufreißerträger einbauen. Bügel (4) und (5), sowie Stange (6) einbauen. Beilage (7) mit zwei Muttern (8) auf der Stange (6) einbauen.

Instale el indicador entre el cilindro hidráulico superior derecho y la viga del desgarrador. Instale las abrazaderas (4) y (5) y la varilla (6). Instale la arandela (7) en la varilla (6) usando dos tuercas (8).



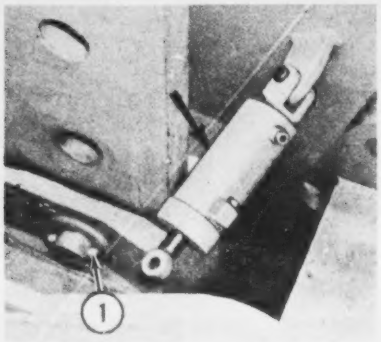
10 Put grease on each shank and install the shank or shanks from under the ripper beam. Install the shank locking pin. Put grease in all fittings and fill the hydraulic tank.

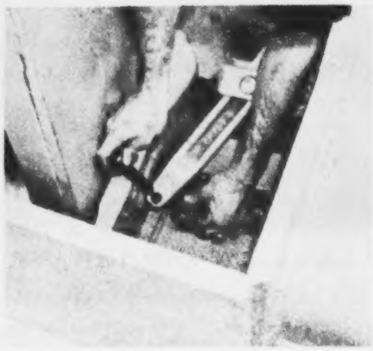
Mettre de la graisse sur chaque dent et monter la dent ou les dents par le dessous du porte-dent du ripper. Monter la broche de blocage de la dent. Graisser à tous les graisseurs et remplir le réservoir d'huile de la commande hydraulique.

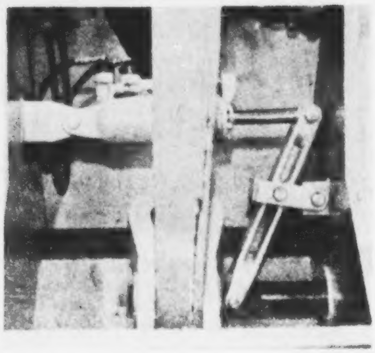
Jeden Reißschenkel einschmieren und von unten her einbauen. Sperrbolzen einbauen. Alle Schmiernippel abschmieren und Hydrauliktank nachfüllen.

Coloque grasa en cada vástago e instale el vástago o vástagos desde el lado de abajo en la viga de desgarrador. Instale el pasador de traba del vástago. Coloque grasa en todas las graseras y llene el tanque hidráulico.

HYDRAULIC PIN PULLER (IF EQUIPPED)
EXTRACTEUR HYDRAULIQUE DE BROCHE DE DENT (MACHINES COMPORTANT CET ACCESSOIRE)
HYDRAULISCHER BOLZENZIEHER (FALLS SO AUSGERÜSTET)
EXTRACTOR DE PASADOR HIDRAULICO (SI ESTA EQUIPADO CON ESTE)





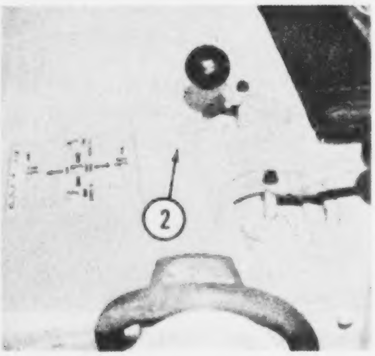


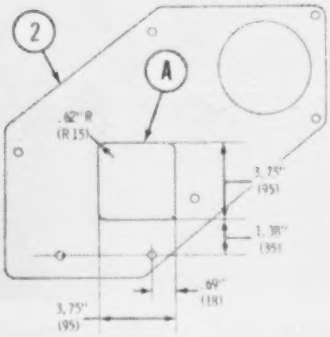
1 Remove pin (1). Install the pin puller cylinder, the new pin and the linkage to the ripper beam assembly.

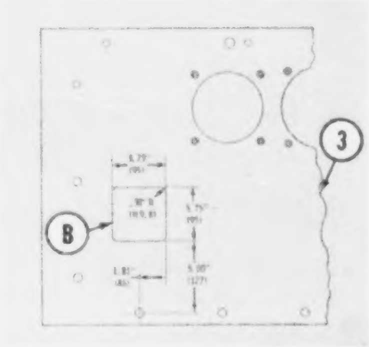
Retirer la broche (1). Monter le vérin de l'extracteur, la nouvelle broche et la tringlerie allant au porte-dent du ripper.

Bolzen (1) ausziehen. Bolzenzieherzylinder, neuen Bolzen und Gestänge am Aufreißerträger anbauen.

Remueva el pasador (1). Instale el cilindro extractor de pasador, el nuevo pasador y el varillaje a la viga de desgarrador.





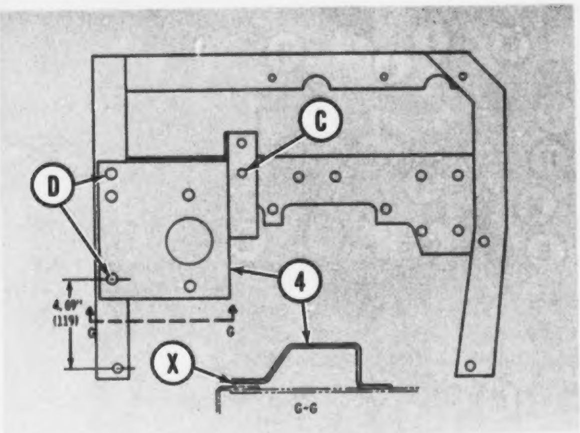


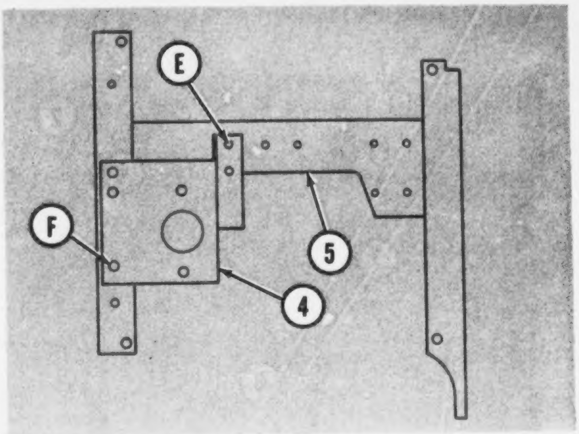
2 If the machine is equipped with a cab, cut opening (A) in cover (2) as shown. If the machine is not equipped with a cab, cut opening (B) in cover (3) as shown.

Si la machine comporte une cabine, découper une ouverture (A) dans le couvercle (2) comme représenté. Si la machine ne comporte pas de cabine, découper l'ouverture (B) dans le couvercle (3) comme représenté.

Wenn die Maschine mit einem Fahrerhaus ausgerüstet ist, eine Öffnung (A) in die Verkleidung (2), wie gezeigt, schneiden. Wenn die Maschine nicht mit einem Fahrerhaus ausgerüstet ist, Öffnung (B) in die Verkleidung (3), wie gezeigt, schneiden.

Si la máquina está equipada con una cabina, corte la abertura (A) en la tapa (2), como se muestra. Si la máquina no tiene cabina, corte la abertura (B) en la tapa (3), como se muestra.



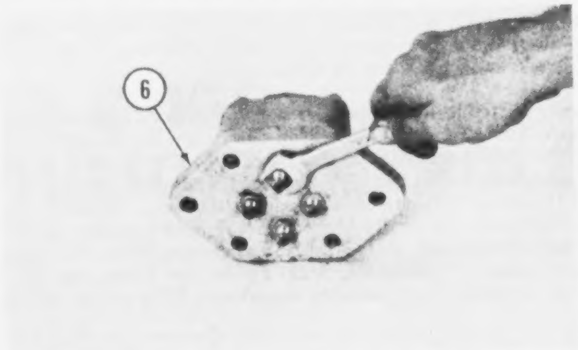


❸ If the machine is equipped with a cab, drill one .406"Ø (Ø10.3) hole (C) and two .531"Ø (Ø13.4) holes (D) in the support using bracket (4) as a guide. Install the bracket using two washers (X) at locations (D), bolts, lockwashers and nuts. On machines that do not have a cab it is not necessary to drill holes in support (5). To fasten bracket (4), install weld nuts under support (5) at locations (E) and (F) using a .12" (3.0) fillet weld.

Si la machine comporte une cabine, percer un trou (C) de Ø 0.406" (10,3) et deux trous (D) de Ø 0.531" (13,4) dans le support en utilisant le support (4) comme gabarit. Monter le support en plaçant deux rondelles (X) en (D) et fixer par les vis, rondelles Grower et écrous. Sur les machines sans cabine, il n'y a pas à percer de trous dans le support (5). Pour fixer le support (4), souder des écrous sous le support (5) en (E) et (F) par un cordon de 0.12" (3,0).

Wenn die Maschine mit einem Fahrerhaus ausgerüstet ist, ein Loch (C) mit 0,406" (10,3) Ø und zwei Löcher (D) mit 0,531" (13,4) Ø in den Träger bohren; Bügel (4) als Schablone verwenden. Bügel mit zwei Beilagen (X) bei (D), Schrauben, Federscheiben und Muttern einbauen. An Maschinen ohne Fahrerhaus brauchen die Löcher nicht in den Träger (5) gebohrt zu werden. Zum Anbau der Bügel (4) Schweißmuttern unter dem Träger (5) bei (E) und (F) mit 0,12" (3,0) Kehlnähten anbringen.

Si la máquina está equipada con una cabina, haga una perforación de 0,406" (10,3) de diámetro (C) y dos perforaciones de 0,531" (13,4) de diámetro (D) en el soporte usando la abrazadera (4) como guía. Instale la abrazadera usando las arandelas (X) en los puntos (D), pernos, arandelas de presión y tuercas. En máquinas que no tienen cabina no es necesario hacer las perforaciones en el soporte (5). Para unir la abrazadera (4), instale tuercas soldadas debajo de soporte (5) en los puntos (E) y (F) haciendo soldaduras de filete de 0,12" (3,0).

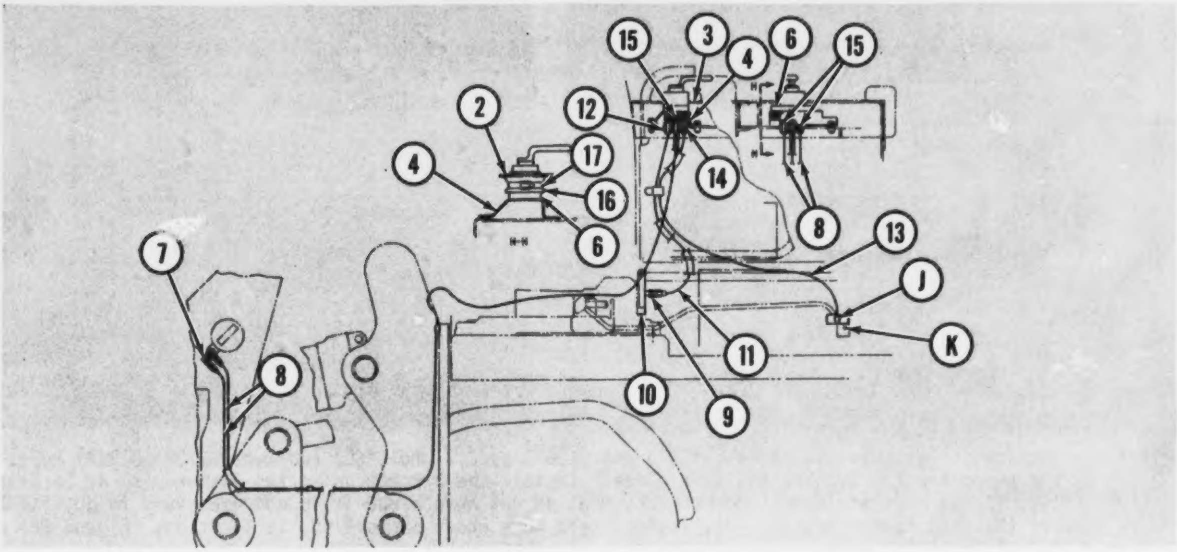


❹ Install flange (6) to the control valve. Install the four connectors as shown using seals.

Monter l'embase (6) sur la vanne. Monter les quatre raccords comme représenté, sans omettre les joints.

Flansch (6) am Steuerventil anbauen. Die vier Verbinder mit Dichtungen, wie gezeigt, einbauen.

Instale la brida (6) a la válvula de control. Instale los cuatro conectores, como se muestra, usando sellos.



⑤ Install two adapters, seals, connectors and elbows (7) to the hydraulic cylinder. Install two 3P6047 Hoses (8) to the cylinder as shown. Install a 5J7303 Elbow (9) in the new brake booster cover (10). Remove the former cover and install cover (10) to the brake booster on the right side of the machine. Install 3P6048 Hose (11) to elbow (9) and connector (12). On a power shift machine, install a connector and seal at location (J); on a direct drive machine install the connector at location (K). Install 3P6049 Hose (13) at location (J) or (K) and at connector (14). Install hoses (8) to connectors (15) as shown. Fasten flange (6) to bracket (4) with two bolts and lockwashers. Install all clips. If the machine is equipped with a cab, install seal (16) and clamp (17). NOTE: Make clamp (17) fit the control valve before installing seal (16). Install cover (2) or (3) and any other parts removed. Fill the hydraulic tank and check for leaks.

Monter les raccords, joints, et coudes (7) sur le vérin hydraulique. Monter les deux flexibles 3P6047 (8) sur le vérin comme représenté. Monter le coude 5J7303 (9) sur le nouveau couvercle (10) du servo de frein. Enlever le couvercle en place et monter à la place le couvercle (10) sur le servo de frein, du côté droit de la machine. Brancher le flexible 3P6048 (11) au coude (9) et raccord (12). Sur les machines à transmission Power Shift, monter un raccord et joint en (J); sur les machines à boîte de vitesses mécanique, monter le raccord en (K). Brancher le flexible 3P6049 (13) en (J) ou (K) et sur le raccord (14). Brancher les flexibles (8) aux raccords (15) comme représenté. Fixer l'embase (6) au support (4) avec deux vis et rondelles Grower. Monter les colliers de fixation. Si la machine comporte une cabine, monter le joint (16) et le collier (17). NOTA : Ajuster le collier (17) sur la vanne avant de monter le joint (16). Monter le couvercle (2) ou (3) ainsi que toute autre pièce que l'on avait enlevée. Faire le plein du réservoir d'huile de la commande hydraulique et s'assurer qu'il n'y a pas de fuites.

Zwei Anschlüsse, Dichtungen, Verbinder und Bogen (7) am Hydraulikzylinder anbauen. Zwei Schläuche 3P6047 (8), wie gezeigt, am Zylinder anbauen. Einen Bogen 5J7303 (9) in den neuen Bremsverstärkerdeckel (10) einbauen. Früheren Deckel abbauen und Deckel (10) am Bremsverstärker an der rechten Maschinenseite einbauen. Schlauch 3P6048 (11) am Bogen (9) und Verbinder (12) anschließen. An Maschinen mit Lastschaltgetriebe, einen Verbinder und eine Dichtung bei (J) einbauen; an Maschinen mit Direktantrieb, den Verbinder (K) einbauen. Schlauch 3P6049 (13) bei (J) oder (K) und am Verbinder (14) anschließen. Schläuche (8) an die Verbinder (15), wie gezeigt, anschließen. Flansch (6) am Bügel (4) mit zwei Schrauben und Federscheiben anbauen. Alle Klemmen einbauen. Wenn die Maschine mit einem Fahrerhaus ausgerüstet ist, Dichtung (16) und Klemme (17) einbauen. MERKE: Vor dem Einbau der Dichtung (16) die Klemme (17) am Steuerventil anpassen. Deckel (2) oder (3) und sonstige ausgebaute Teile wieder einbauen. Hydrauliktank füllen und auf Lecks prüfen.

Instale dos adaptadores, sellos, conectores y codos (7) al cilindro hidráulico. Instale dos Mangueras 3P6047 (8) al cilindro, como se muestra. Instale un Codo 5J7303 (9) en la nueva tapa (10) del reforzador del freno. Remueva la tapa antigua e instale la tapa (10) al reforzador del freno en el lado derecho de la máquina. Instale la Manguera 3P6048 (11) al codo (9) y conector (12). En una máquina con servotransmisión, instale un conector y sello en el punto (J). En una máquina de transmisión mecánica, instale el conector en el punto (K). Instale Manguera 3P6049 (13) en el punto (J) o (K) y en el conector (14). Instale las mangueras (8) a los conectores (15), como se muestra. Una la brida (6) a la abrazadera (4) con dos pernos y arandelas de presión. Instale todas las grampas. Si la máquina está equipada con cabina, instale sello (16) y grampa (17). NOTA: Haga que la grampa (17) ajuste en la válvula de control, antes de instalar el sello (16). Instale la tapa (2) o (3) y cualquiera otra parte que se haya removido. Llene el tanque hidráulico y compruebe para ver si hay filtraciones.

FORM NO. SENR7008

SERVICE
MANUAL

173, 183 & 193
HYDRAULIC CONTROLS

SERIAL NUMBERS

173:	183:	193:
20C1-UP	27A1-UP	42V1-UP
28A1-UP	41V1-UP	

INTRODUCTION

This publication has instructions and procedures for the subject on the front cover. The information, specifications, and illustrations in this publication are on the basis of information that was current at the time this issue was written.

Correct operation, maintenance, test and repair procedures will give this product a long service life. Before starting a test, repair or rebuild job, the serviceman must read the respective sections of the Service Manual, and know all the components he will work on.

Your safety, and the safety of others, is at all times very important. When you see this symbol ⊕ or this symbol ⚠ in the manual, you must know that caution is needed for the procedure next to it. The symbols are warnings. To work safely, you must understand the job you do. Read all instructions to know what is safe and what is not safe.

It is very important to know the weight of parts. Do not lift heavy parts by hand. Use a hoist. Make sure heavy parts have a good stability on the ground. A sudden fall can cause an accident. When lifting part of a machine, make sure the machine has blocks at front and rear. Never let the machine hang on a hoist, put blocks or stands under the weight.

When using a hoist, follow the recommendation in the manual. Use correct lift tools as shown in illustrations to get the correct balance of the component you lift. This makes your work safer at all times.

40400X3

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173 HYDRAULIC COMPONENTS

OPTIONS	173 HYDRAULIC COMPONENTS									
	Dozer Lift Cylinders	Tilt Cylinder	Quick-drop Valves (lift cylinders)	Dozer Lift Control Valve	Main Relief Valve	Tilt Control Valve	Ripper-Control Valve	Restrictor Valve	Pilot Valve (dozer tilt)	Pilot Valve (ripper lift)
Bulldozer	X		X	X	X					
Dozer and Ripper (solid top link)	X		X	X	X		X	X		X
Dozer and Tilt Cylinder	X	X	X	X	X	X		X	X	
Dozer, Tilt Cylinder and Ripper (solid top link)	X	X	X	X	X	X	X	X	X	X

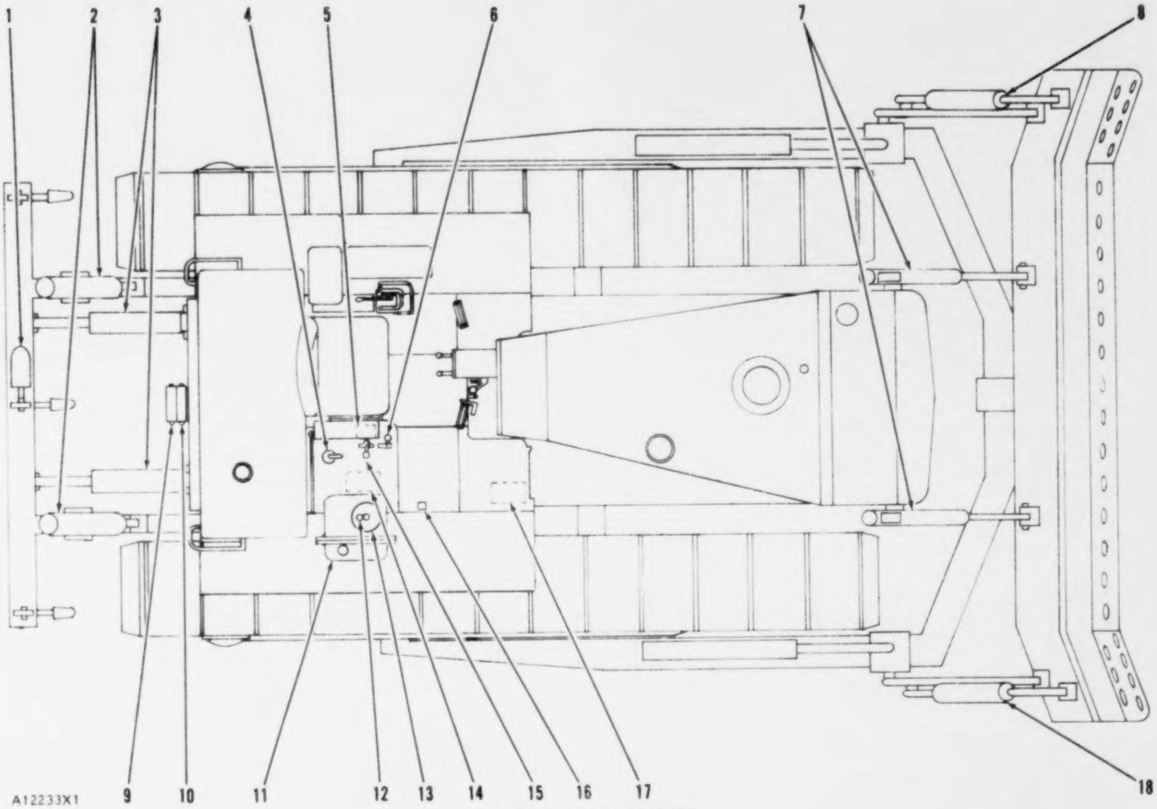
183 HYDRAULIC COMPONENTS

OPTIONS	183 HYDRAULIC COMPONENTS													
	Dozer Lift Cylinders	Tilt Cylinder	Quick-drop Valves (lift cylinders)	Tilt Relief Valve	Dozer Lift Control Valve	Main Relief Valve	Tilt Control Valve	Ripper Control Valve	Restrictor Valve	Pilot Valve (Dozer Tilt)	Pilot Valve (Ripper Lift)	Pilot Valve (Ripper Tip)	Ripper Lift Cylinders	Ripper Variable Pitch Cylinders
Bulldozer	X		X		X	X								
Dozer and Ripper (solid top link)	X		X		X	X		X	X		X		X	
Dozer and Tilt Cylinder	X	X	X	X	X	X	X		X	X				
Dozer, Tilt Cylinder and Ripper (solid top link)	X	X	X	X	X	X	X	X	X	X	X		X	
Dozer and Ripper (varible pitch)	X		X		X	X		X	X	X	X	X	X	X
Dozer, Tilt Cylinder and Ripper (variable pitch)	X	X	X	X	X	X	X	X	X	X	X	X	X	X

193 HYDRAULIC COMPONENTS

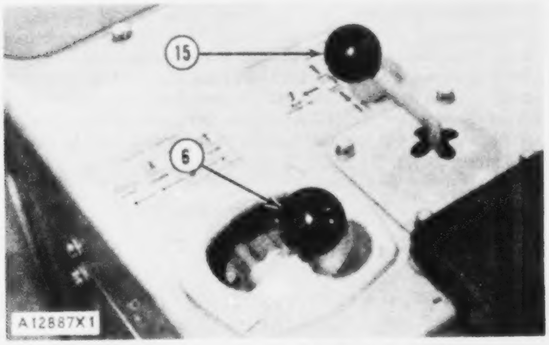
OPTIONS	193 HYDRAULIC COMPONENTS														
	Dozer Lift Cylinders	Tilt Cylinder	Quick-drop Valves (lift cylinders)	Tilt Relief Valve	Dozer Lift Control Valve	Main Relief Valve	Tilt Control Valve	Ripper Control Valve	Restrictor Valve	Pilot Valve (Dozer Tilt)	Pilot Valve (Ripper Lift)	Pilot Valve (Ripper Tip)	C-Dozer Lift Cylinder (one)	Ripper Lift Cylinders	Ripper Variable Pitch Cylinders
Bulldozer	X		X		X	X									
C-Dozer					X	X							X		
C-Dozer and Ripper (solid top link)					X	X		X			X		X	X	
Dozer and Ripper (solid top link)	X		X		X	X		X			X			X	
Dozer and Tilt Cylinder	X	X	X	X	X	X	X			X					
Dozer, Tilt Cylinder and Ripper (solid top link)	X	X	X	X	X	X	X	X		X	X			X	
C-Dozer and Ripper (variable pitch)					X	X		X	X		X	X	X	X	X
Dozer and Ripper (variable pitch)	X		X		X	X		X	X		X	X		X	X
Dozer, Tilt Cylinder and Ripper (variable pitch)	X	X	X	X	X	X	X	X	X	X	X	X		X	X

COMPONENT LOCATION



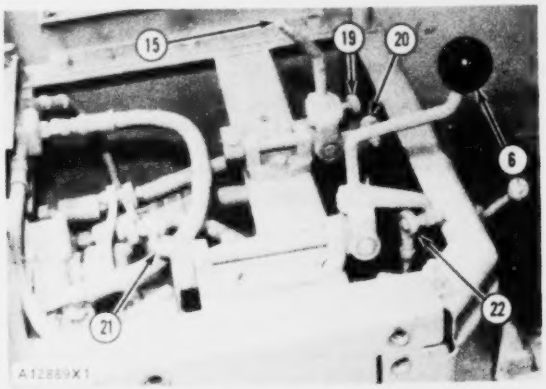
COMPONENT LOCATION

1. Pin puller cylinder. 2. Cylinders for ripper lift. 3. Cylinders for ripper tip. 4. Control valve for pin puller. 5. Pilot valves (three). 6. Control lever for dozer lift and tilt. 7. Cylinders for dozer lift. 8. Cylinder for dozer tilt. 9. Control valve for ripper tip. 10. Control valve for ripper lift. 11. Hydraulic tank. 12. Filter indicator. 13. Filter. 14. Control valve for dozer lift and tilt. 15. Control lever for ripper lift and tip. 16. Restrictor valve. 17. Hydraulic pump. 18. Cylinder for dozer tilt (optional).



DOZER AND RIPPER CONTROL LEVERS

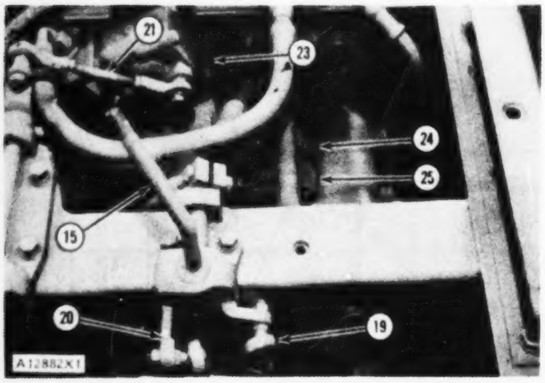
15. Control lever for ripper lift and tip. 6. Control lever for dozer lift and tilt.



CONTROL VALVE LINKAGE

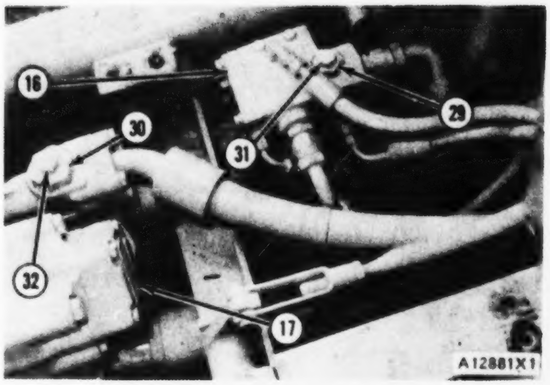
15. Control lever for ripper lift and tip. 6. Control lever for dozer lift and tilt. 19. Linkage to pilot valve for ripper tip. 20. Linkage to pilot valve for ripper lift. 21. Linkage to control valve for dozer lift. 22. Linkage to pilot valve for dozer tilt.

COMPONENT LOCATION



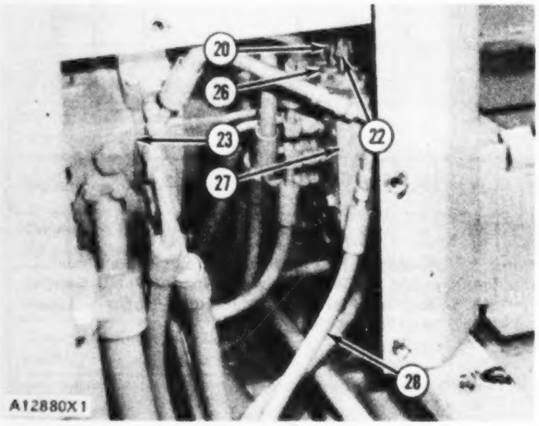
DOZER CONTROL VALVE AND RELIEF VALVES

15. Control lever for ripper lift and tip. 19. Linkage to pilot valve for ripper tip. 20. Linkage to pilot valve for ripper lift. 21. Linkage to control valve for dozer lift. 23. Dozer control valve. 24. Relief valve for main system pressure. 25. Relief valve for tilt system pressure.



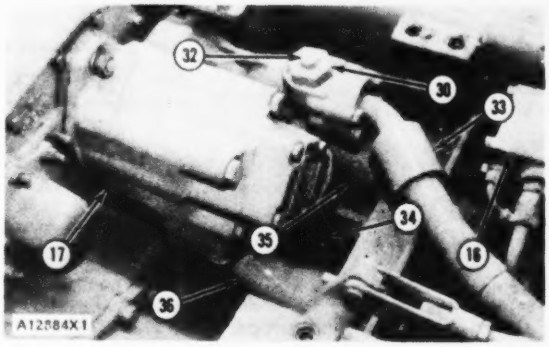
PRESSURE TAPS AND TEE TAPS

16. Restrictor valve. 17. Hydraulic pump. 29. Tee tap (small section of pump). 30. Tee tap (large section of pump). 31. Pressure tap (small section of pump). 32. Pressure tap (large section of pump).



PILOT VALVES

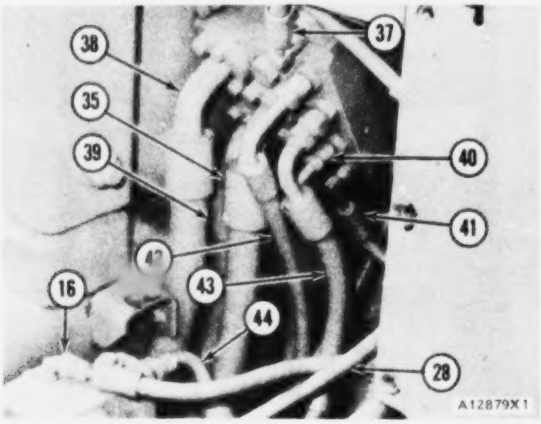
20. Linkage to pilot valve for ripper lift. 22. Linkage to pilot valve for dozer tilt. 23. Dozer control valve. 26. Pilot valve for ripper lift. 27. Pilot valve for dozer tilt. 28. Supply line for pilot pressure oil (from restrictor valve).



HYDRAULIC PUMP

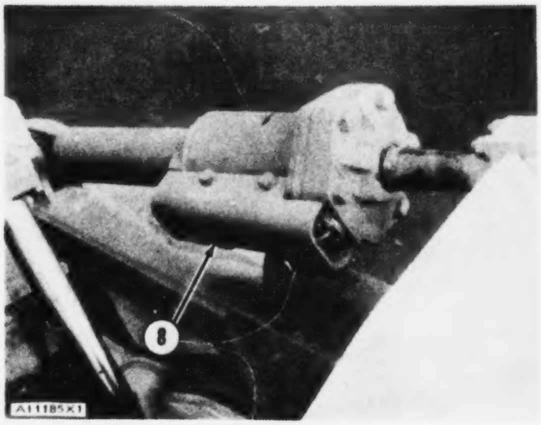
16. Restrictor valve. 17. Hydraulic pump. 30. Tee tap (large section of pump). 33. Supply line for pressure oil from large section of the pump to the ripper control valve. 34. Supply line for pressure oil from the small section of the pump to the restrictor valve. 35. Supply line for pressure oil from the large section of the pump to the dozer control valve (lift). 36. Supply line for oil from the hydraulic tank to the pump.

COMPONENT LOCATION



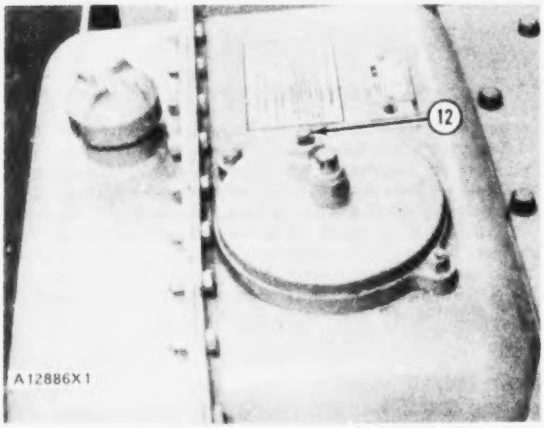
LINES FOR DOZER CONTROL VALVE

16. Restrictor valve. 28. Supply line for pilot pressure oil (from restrictor valve). 35. Supply line for pressure oil from the large section of the pump. 37. Supply line for pilot oil to the control valve for blade tilt. 38. Supply line for pressure oil to the head end of the dozer lift cylinders. 39. Supply line for pressure oil to the rod end of the lift cylinders. 40. Supply line for pressure oil to the rod end of the tilt cylinder. 41. Supply line for pilot oil to the control valve for blade tilt. 42. Supply line for pressure oil to the head end of the tilt cylinder. 43. Supply line for pressure oil from the restrictor valve. 44. Supply line from small section of the pump.



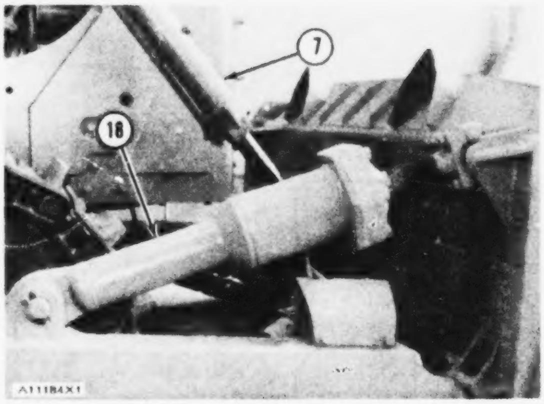
TILT CYLINDER

8. Cylinder for dozer tilt (installed on left side of dozer).



FILTER INDICATOR

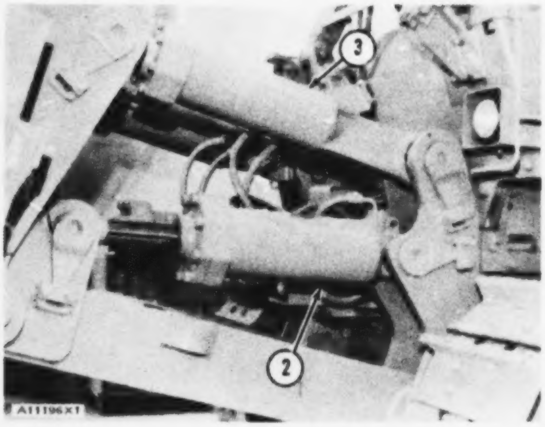
12. Filter indicator.



TILT CYLINDER (OPTIONAL)

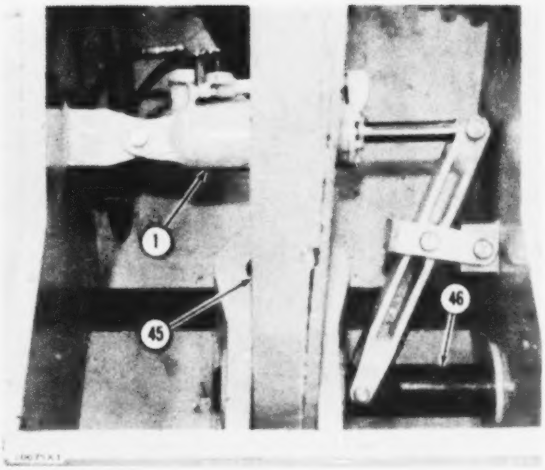
7. Cylinder for dozer lift. 18. Cylinder for dozer tilt (installed on right side of dozer).

COMPONENT LOCATION



RIPPER CYLINDERS

2. Cylinders for ripper lift. 3. Cylinders for ripper tip

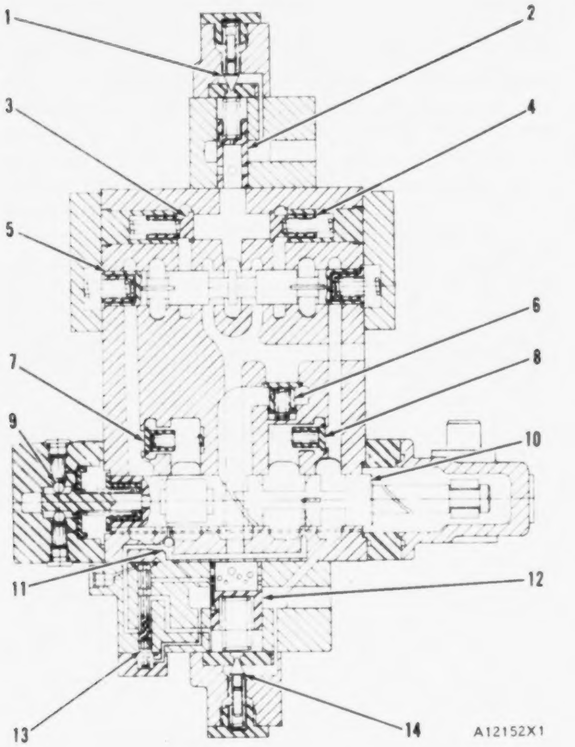


PIN PULLER

1. Pin puller cylinder. 45. Ripper shank. 46. Pin.

SYSTEMS OPERATION

INTRODUCTION



CONTROL VALVE FOR BLADE LIFT AND TILT

1. Pilot valve for tilt relief. 2. Dump valve for small section of pump. 3. Load check valve for head end of tilt cylinder. 4. Load check valve for rod end of tilt cylinder. 5. Spool for control valve for blade tilt. 6. Load check valve for blade lift circuit. 7. Make-up valve for rod end of lift cylinders. 8. Make-up valve for head end of lift cylinders. 9. Detent. 10. Spool for control valve for blade lift. 11. Ball resolver valve. 12. Dump valve for large section of pump. 13. Shuttle valve. 14. Pilot valve for blade lift relief.

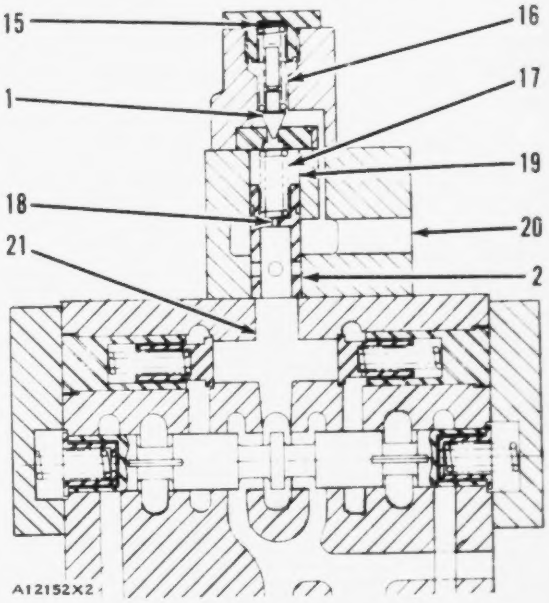
The main control valve for blade lift and tilt has two spools; one for blade lift and lower and one for blade tilt. The blade lift spool is manually operated and has four positions; RAISE, HOLD, LOWER and FLOAT. Only the FLOAT position has detents. The blade tilt spool is operated with pilot pressure oil and has three positions; TILT RIGHT, HOLD and TILT LEFT. None of these positions have a detent. The tilt circuit is a modified series circuit with the lift circuit for small section pump flow. When the tilt spool is moved for tilt right or left, the pump flow from the small section of the pump is stopped from going into the blade lift part of the valve. Both the tilt and the lift sections have load check valves and relief valves. The blade lift circuit has cylinder to tank make-up valves for both the rod ends and head ends of the lift cylinders.

CONTROL VALVE FOR BLADE TILT

Hydraulic oil, from the small section of the pump, is sent through the restrictor valve to the blade tilt control valve. The tilt control valve is a three position valve; TILT RIGHT, HOLD and TILT LEFT. It is operated with pilot pressure oil and is activated by moving the lever for dozer control to the right or left.

When tilt spool (5) is moved to the left, pressure oil is sent to the rod end of the tilt cylinder and the blade tilts to the right. Movement of the spool in the opposite direction, past HOLD position, sends pressure oil to the head end of the tilt cylinder and the blade tilts to the left. Load check valves (3) and (4) prevent cylinder drift during valve spool movement. All pressure oil, for movement of the blade, must go through one of the load check valves to the rod or head end of the tilt cylinder. There are springs installed at both ends of spool (5). These are used to return the spool to a center (HOLD) position.

RELIEF VALVE FOR TILT CIRCUIT



RELIEF VALVE FOR TILT CIRCUIT

1. Pilot valve for tilt relief. 2. Dump valve for small section of pump. 15. Shims. 16. Spring. 17. Spring. 18. Orifice. 19. Chamber. 20. Outlet to tank.

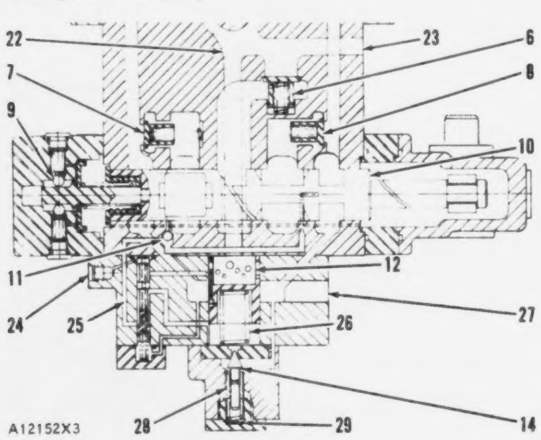
The pressure relief valve prevents high pressures from causing damage to components in the tilt circuit. It is a part of the main control valve assembly.

Oil, from the small section of the pump, goes into chamber (21). From there it goes through orifice (18) into chamber (19). Dump valve (2) is normally held closed by the force of spring (17).

When oil pressure increases to the maximum setting of the relief valve, pilot valve (1) opens and the oil in chamber (19) goes to tank through outlet (20). When the pilot valve opens, the pressure in chamber (19) decreases. The pressure in chamber (21) is more than the pressure in chamber (19) and the force of spring (17). Dump valve (2) moves against the force of spring (17) and opens a passage for oil flow from chamber (21) to outlet (20). This lets the oil from the small section of the pump return directly to tank. As the pressure in the circuit returns to normal, pilot valve (1) is closed by the force of spring (16) and dump valve (2) is closed by the force of spring (17). Use shims (15) to make an adjustment for opening pressure of the relief valve.

CONTROL VALVE FOR BLADE LIFT

Hydraulic oil, from the large section of the pump, goes into the control valve for blade lift at inlet (23). From there it goes into passage (22) where it mixes with the oil from the tilt valve. From passage (26), the flow of both pumps go down through dump valve (12) and back to tank through outlet (27).



CONTROL VALVE FOR BLADE LIFT

6. Load check valve for blade lift circuit. 7. Make-up valve for rod end of lift cylinders. 8. Make-up valve for head end of lift cylinders. 9. Detent. 10. Spool for control valve for blade lift. 11. Ball resolver valve. 12. Dump valve for large section of pump. 13. Shuttle valve. 14. Pilot valve for blade lift relief. 22. Passage. 23. Inlet for oil from large section of pump. 24. Inlet for pilot oil. 25. Passage. 26. Spring. 27. Outlet to tank. 28. Spring. 29. Shims.

The control valve for blade lift is a four position valve; RAISE, HOLD, LOWER and FLOAT. It is manually operated by the blade control lever. Movement of the lever to the rear sends pressure oil to the rod end of the lift cylinder and the blade will raise. Forward movement of the lever sends pressure oil to the head end of the lift cylinders, lowering the blade. If the lever is pushed forward, past the LOWER position, it will go into the FLOAT position. The FLOAT position is the only position with a detent. In this position the blade is free to move up or down according to the outside forces.

When the blade control lever is moved to the RAISE position, control valve spool (10) is moved out of the body of the valve. As the pressure increases, load check valve (6) opens and pressure oil is sent through the quick-drop valves to the rod end of the lift cylinders. This action causes the blade to raise. Return oil, from the head ends of the cylinders goes back to tank through the control valve.

When the blade control lever is moved to the LOWER position, the control valve spool moves into the valve body. As the pressure increases, load check valve (6) opens and pressure oil is sent through the quick-drop valves to the head end of the lift cylinders. This action causes the blade to lower. Return oil from the rod end of the cylinders can add to the oil going to the head ends of the cylinders or return to tank through the control valve.

RELIEF VALVE FOR LIFT CIRCUIT (DUMP SPOOL OPERATION)

The dump spool works in four different ways: 1. To dump the pump flow when control valves are in HOLD position. 2. As a pressure compensation valve for the pump. 3. To give flow control. 4. As a relief valve for main system operation.

When the blade lift or ripper control spools are in HOLD position, the pressure behind dump spool (12) is the same as tank pressure plus approximately 80 psi (5.6 kg/cm^2) caused by spring (26). During blade raise or lower, the pressure in the chamber behind the dump spool is the same as the pressure in the rod or head end of the cylinders (the end that is getting pump flow at the time). This pressure is felt through ball resolver (11) and shuttle valve (13). With this cylinder pressure plus the spring force behind the dump spool, the pump pressure will be raised to a level about 80 psi (5.6 kg/cm^2) above the cylinder pressure (pressure compensation). Flow control and fine modulation is possible because of the constant 80 psi (5.6 kg/cm^2) pressure behind the dump spool.

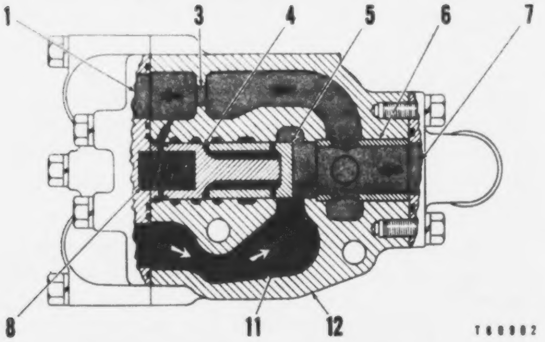
When the ripper control valve is activated, (raise or tip) pilot pressure oil is sent to inlet (24) where it moves the spool in shuttle valve (13). Movement of the spool in the shuttle valve closes the passage to ball resolver (11) and opens a passage to let pump oil get behind dump spool (12). The dump spool now becomes a relief valve. All of the output of the pump is sent to operate the ripper.

QUICK-DROP VALVES

A quick-drop valve is installed on the head end of each of the cylinders for blade lift. These valves will let the dozer blade drop very fast. The valves also permit the application of down pressure when the blade is on the ground.

When the control valve for blade lift is moved to the RAISE position, oil flow goes in the valve at inlet (1) through orifice (3) and sleeve (6) and out through outlet (7) to the rod end of the lift cylinder. A small amount of the oil flow goes through orifice (2) and fills the chamber behind plunger (4). The pressure of this oil adds to the force of spring (8) which pushes valve (5) and plunger (4) against sleeve (6). When valve (5) is pushed against sleeve (6), the head end outlet (11) is closed from the flow of oil to the rod end of the cylinder. Oil from the head end of the cylinder comes into the valve at outlet (11) and returns to the control valve through inlet (9).

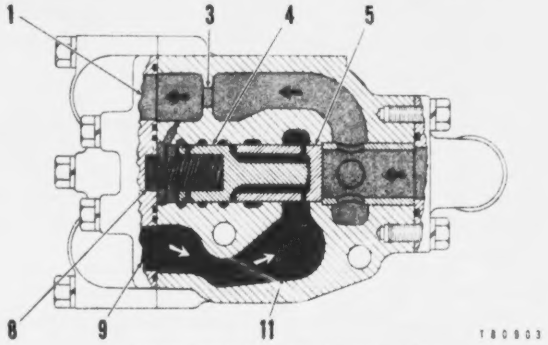
When the blade is being lowered without resistance, the weight of the blade sends oil from the rod end of the cylinder, through the quick-drop valve and back to the control valve for blade lift. As the oil goes through orifice (3), a pressure increase is caused in the rod end of the cylinder. This pressure pushes against the face of valve (5) causing it and plunger (4) to move against the force of spring (8). Return oil from the rod end of the cylinder is then added to the flow of oil from the control valve to the head end of cylinder. This lets the blade drop very fast.



QUICK-DROP VALVE OPERATION
(Blade Lower, Quick-Drop)

1. Inlet from control valve. 3. Orifice. 4. Plunger. 5. Valve. 6. Sleeve. 7. Outlet to rod end of cylinder. 8. Spring. 11. Outlet to head end of cylinder. 12. Valve body.

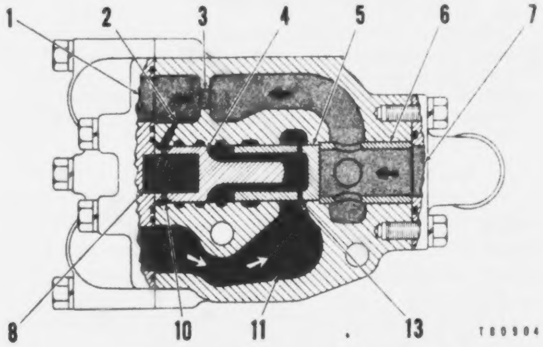
A small movement of the lever for blade control to the LOWER position, lets the blade lower slowly without quick-drop valve action. In this case, the oil flow, from the rod end of the cylinder, is not enough to cause a pressure increase large enough to move valve (5) and plunger (4). All of the oil from the rod end goes back to the control valve. Only the pressure oil goes to the head end.



QUICK-DROP VALVE OPERATION
(Blade Lower, Slow Speeds)

1. Inlet from control valve. 3. Orifice. 4. Plunger. 5. Valve. 8. Spring. 9. Inlet from control valve. 11. Outlet to head end of the cylinder.

When the blade has been lowered to the ground and resistance to additional movement is more than the weight of the blade, oil flow from the rod end of the cylinder decreases. As the oil flow through orifice (3) becomes less the pressure on the face of sleeve (6) decreases and the force of spring (8) moves valve (5) and plunger (4) back against sleeve (6). All return oil goes to the control valve. All pressure oil is sent to the head end of the cylinder. Passages (13) let part of the pressure oil fill the space between plunger (4) and valve (5), thus giving hydraulic force to hold valve (5) against sleeve (6).



QUICK-DROP VALVE OPERATION
(Blade Lower, Down Pressure)

1. Inlet from control valve. 2. Orifice. 3. Orifice. 4. Plunger. 5. Valve. 6. Sleeve. 7. Outlet to rod end of cylinder. 8. Spring. 10. Passages (two). 11. Outlet to head end of cylinder. 13. Passages (two).

Passages (10) in plunger (4) prevent a hydraulic lock as the plunger moves past orifice (2).

PIN PULLER CONTROL VALVE
(SINGLE SHANK RIPPERS ONLY)

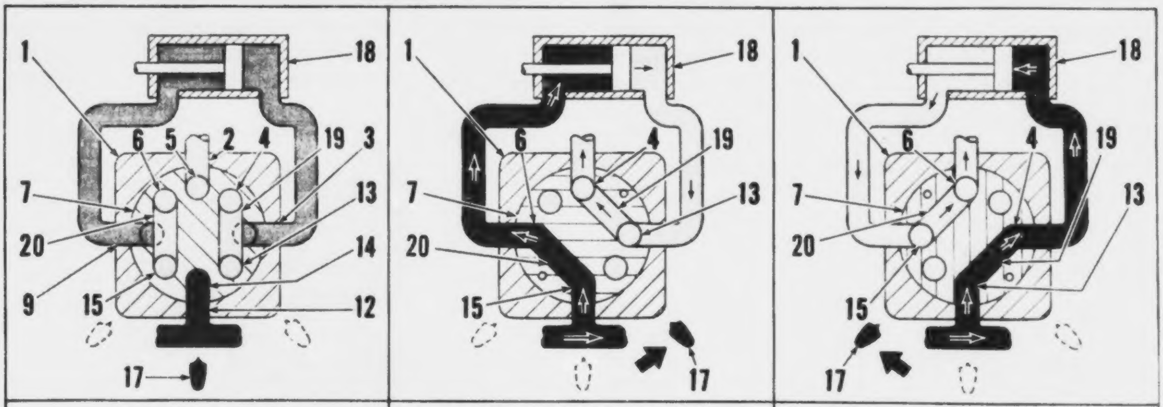


FIG. 2. HOLD POSITION

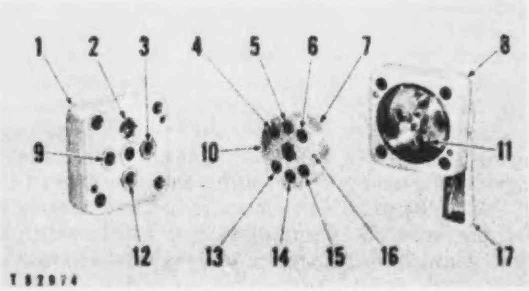
FIG. 3. DISENGAGE PIN POSITION

FIG. 4. ENGAGE PIN POSITION

T82975 ■ PRESSURE OIL ▨ BLOCKED OIL ☐ RETURN OIL

FLOW OF OIL SCHEMATIC

1. Plate. 2. Return oil passage. 3. Passage to head end of pin puller cylinder. 4, 5 and 6. Passages in disk (7). 7. Disk. 9. Passage to rod end of pin puller cylinder. 12. Pressure oil passage. 13, 14 and 15. Passages in disk (7). 17. Handle for control valve. 18. Pin puller cylinder. 19. Passage in disk (7). 20. Passage in disk (7).



PIN PULLER CONTROL VALVE

1. Plate. 2. Return oil passage. 3. Passage to head end of pin puller cylinder. 4, 5 and 6. Passages in disk (7). 7. Disk. 8. Valve body. 9. Passage to rod end of pin puller cylinder. 10. Passage. 11. Seals (six). 12. Pressure oil passage. 13, 14 and 15. Passages in disk (7). 16. Passage. 17. Handle for control valve.

The control valve for the pin puller is a three position valve. The positions are; ENGAGE, HOLD and DISENGAGE. Pressure oil for the pin puller circuit comes from the torque converter. Return oil from the system is sent back to the transmission. The cylinder for the pin puller is installed on the ripper. Through linkage between the pin and the cylinder, the pin can be engaged or disengaged to change the position of the ripper shank.

The pin puller valve is a closed center, rotary valve. The parts of the valve are; plate (1), disk (7) and valve body (8). Movement of the control lever turns the disk, closing or opening passages in the plate. The passage that are open or closed will according to the position of the handle.

The plate has four passages through which oil enters or leaves the control valve. Four holes in the valve body, directly opposite the passages in the plate give hydraulic balance on the sides of the disk. The sides of the disk are connected by passages (4), (5), (6), (13), (14), (15) and small passages (10 and 16). Passages (4) and (13) are connected by passage (19) in the disk and passages (6) and (15) are connected by passage (20) in the disk.

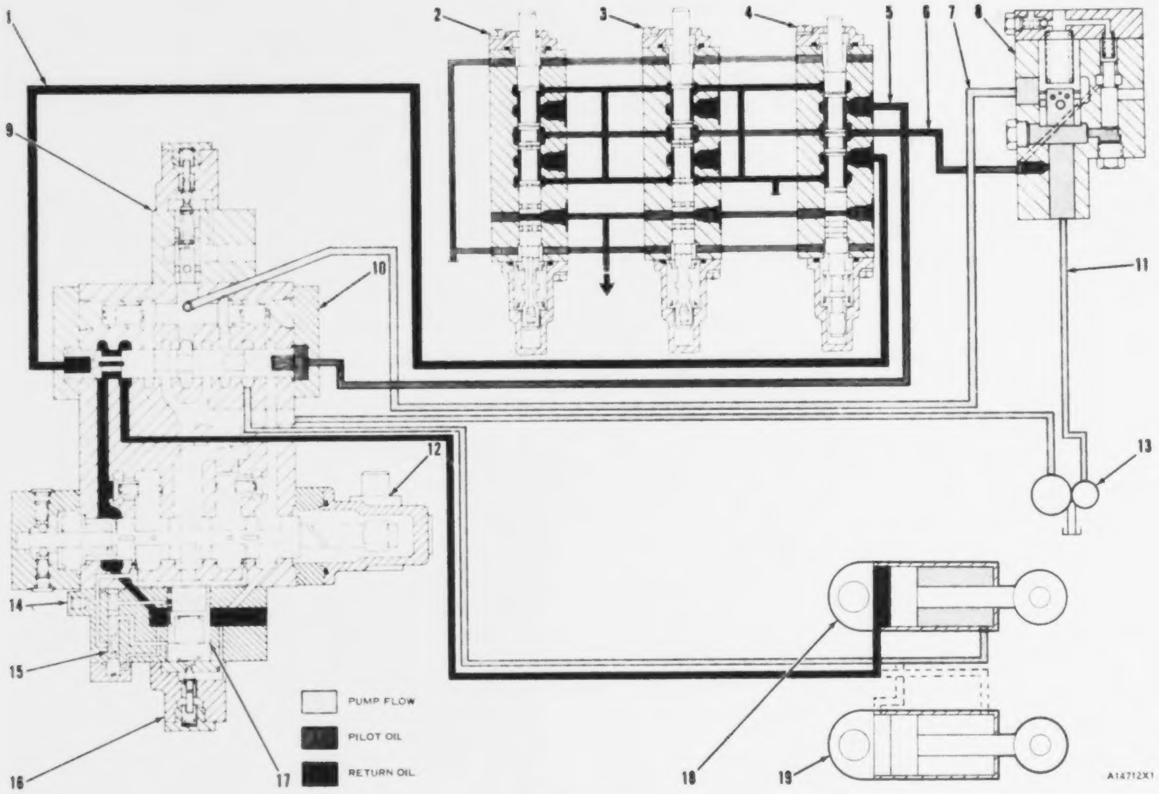
Seals (11) on the face are used to seal the disk to the plate and body. The seals are installed in the plate and body around the passage openings. The return oil passages in the plate and body do not have a seal.

When the handle on the control valve is in the HOLD position, there is no alignment between the passages in the disk and those in the plate or body. Pressure oil in passage (2) and the oil in both ends of the pin puller cylinder is stopped at the disk.

Movement of the handle to the DISENGAGE position turns the disk and makes alignment of the passages in the disk with those in the plate and body. Pressure oil is sent to the rod end of the pin puller cylinder. Return oil from the head end of the cylinder is sent to the oil reservoir in the transmission.

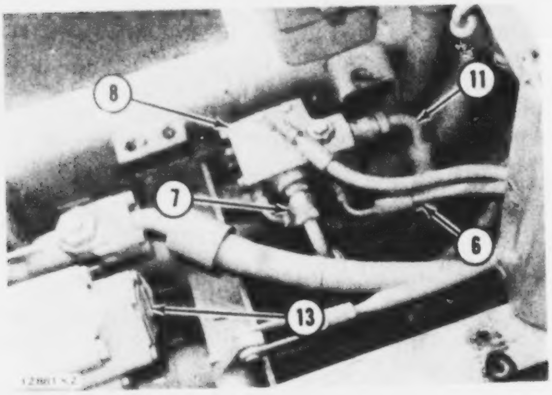
When the handle on the control valve is moved to the ENGAGE position, the flow of oil to the cylinder is reversed.

PILOT SYSTEM



PILOT SYSTEM
(Shown with Dozer Tilt in TILT RIGHT)

1. Line for pilot oil to dozer tilt valve. 2. Pilot valve for ripper tip control. 3. Pilot valve for ripper lift control. 4. Pilot valve for dozer tilt control. 5. Line for pilot oil to dozer tilt valve. 6. Line for pilot oil from restrictor valve (8) to pilot valves. 7. Line for pressure oil from restrictor valve (8) to dozer tilt valve (10). 8. Restrictor valve. 9. Relief valve for dozer tilt circuit. 10. Dozer tilt valve. 11. Line for oil supply from small section of pump (13) to restrictor valve (8). 12. Control valve for dozer lift. 13. Hydraulic pump. 14. Inlet for oil from pilot valves for ripper control. 15. Shuttle valve. 16. Relief valve for dozer lift and ripper circuits. 17. Flow control valve. 18. Cylinder for dozer tilt (installed on left side push arm). 19. Cylinder for dozer tilt (optional, installed on right side push arm).

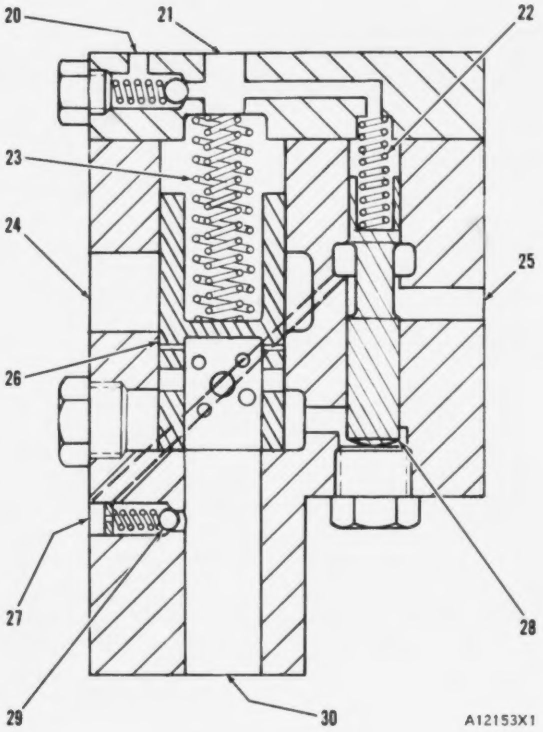


RESTRICTOR VALVE AND LINES

6. Line for pilot oil from restrictor valve (8) to pilot valves. 7. Line for pressure oil from restrictor valve (8) to dozer tilt valve (10). 8. Restrictor valve. 11. Line for oil supply from small section of pump (13) to restrictor valve (8). 13. Hydraulic pump.

Oil flow for the pilot system and dozer tilt circuit comes from the small section (cover end) of hydraulic pump (13). It goes to restrictor valve (8) through line (11).

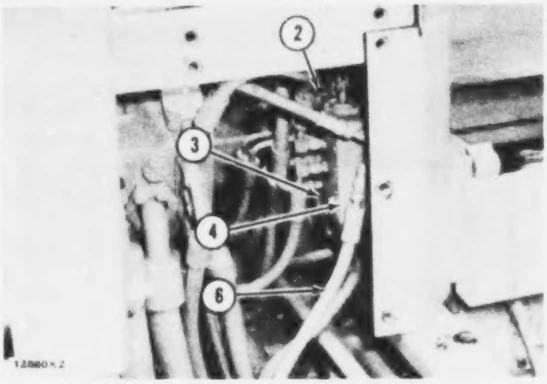
At the restrictor valve, the action of spring (23) and spool (26) causes a pressure of 100 psi (7.0 kg/cm^2) minimum. This pressure is used in the pilot system to activate the main control valves for dozer tilt and ripper lift and tip. After the oil goes past spool (26), it goes out passage (24) through line (7) to the main control valve for dozer operation. The pilot oil goes out of the restrictor valve through passage (27) and line (6) to the pilot valves.



RESTRICTOR VALVE

20. Outlet. 21. Outlet to tank. 22. Spring. 23. Springs. 24. Outlet for pressure oil to main control valve for dozer tilt. 25. Inlet for oil from ripper lift cylinders. 26. Spool. 27. Outlet for pilot oil to pilot valves. 28. Spool. 29. Check valve. 30. Inlet for supply oil from small section of hydraulic pump.

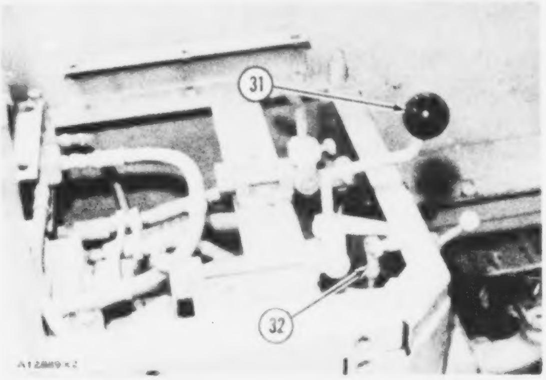
There are three pilot valves. They are the closed center type. There is no oil flow through them when they are in the HOLD position. Pilot valve (2) is used to control the main valve for ripper tip. Pilot valve (3) is used to control the main valve for ripper lift. Pilot valve (4) is used to control the main valve for dozer tilt.



PILOT CONTROL VALVES

2. Pilot valve for ripper tip control. 3. Pilot valve for ripper lift control. 4. Pilot valve for dozer tilt control. 6. Line for pilot oil from restrictor valve (8) to pilot valves.

TILT CIRCUIT



LINKAGE TO PILOT VALVE FOR DOZER TILT CONTROL

31. Lever for dozer lift and tilt control. 32. Linkage to pilot valve for dozer tilt control.

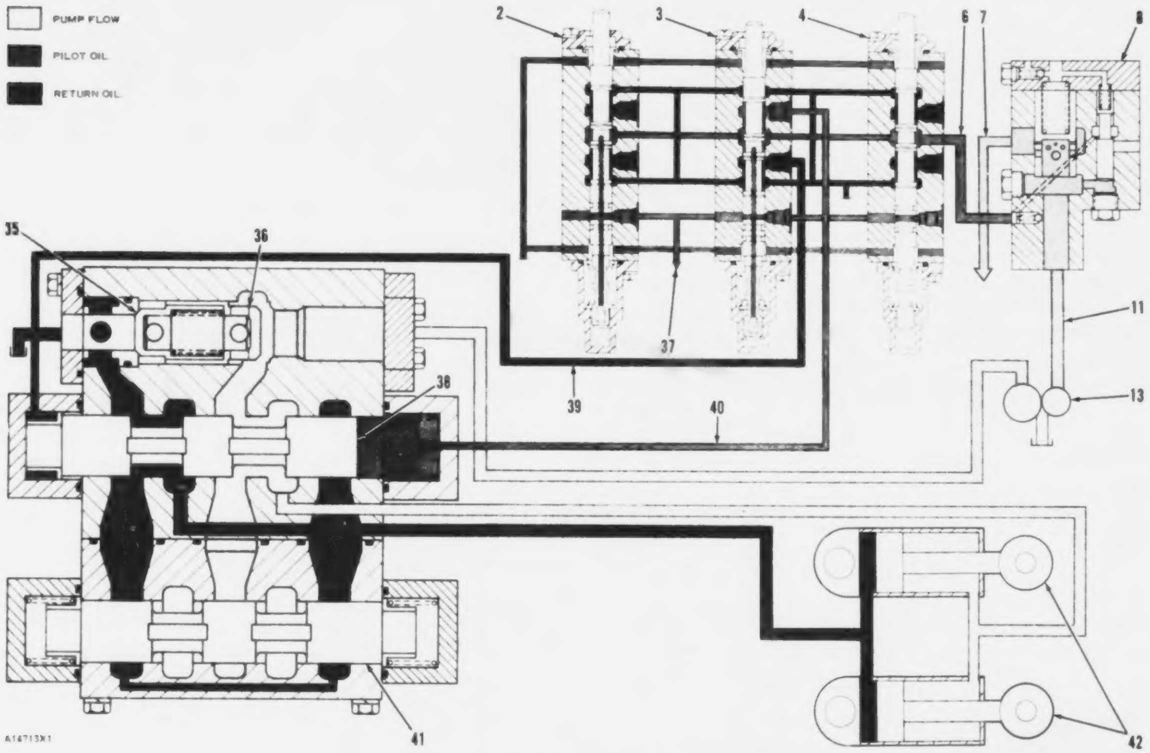
The lever for dozer lift and tilt control (31) is connected, through linkage (32), to pilot valve (4). This pilot valve controls the pilot pressure to dozer tilt valve (10). When lever (31) is moved to the left, pilot pressure is sent through line (5) to the end of the tilt control spool. This pressure causes the tilt spool to move. Movement of the spool opens a passage that lets pressure oil go to the rod end of tilt cylinder (18). Pressure oil to the rod end of the tilt cylinder causes the rod to retract and the dozer blade TILTS LEFT.

NOTE: If the tilt cylinder is installed on the right side push arm the pressure oil for TILT LEFT will go to the head end.

When lever (31) is moved to the right, pilot pressure is sent to the opposite end of the tilt control spool. This causes the spool to move. Movement of the spool opens a passage that lets pressure oil go to the head end of the tilt cylinder. This causes the dozer blade to TILT RIGHT. Return from the cylinder goes back through the control valve to tank.

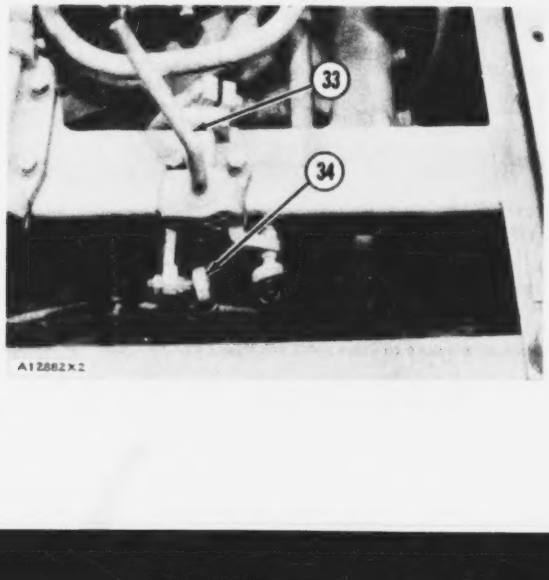
When the tilt spool in the main control valve is moved, it closes off the flow of oil from the small section of the pump to the dozer lift circuit. This does not prevent the dozer circuit from working. If the dozer lift circuit is activated at the same time as the tilt circuit, both circuits will operate.

RIPPER LIFT CIRCUIT



PILOT SYSTEM
(Shown with Ripper Lift Valve Actuated)

2. Pilot valve for ripper tip control. 3. Pilot valve for ripper lift control. 4. Pilot valve for dozer tilt control. 6. Line for pilot oil, from restrictor valve (8) to pilot valves. 7. Line for pressure oil from restrictor valve (8) to dozer tilt valve. 8. Restrictor valve. 11. Line for oil supply from small section of pump (13) to restrictor valve (8). 13. Hydraulic pump. 35. Make-up valve for ripper circuits. 36. Load check valve for ripper circuits. 37. Line for pilot oil to main control valve for dozer lift. 38. Main control valve spool for ripper lift. 39. Line for pilot oil pressure to valve spool for ripper lift. 40. Line for pilot oil pressure to valve spool for ripper lift. 41. Main control valve spool for ripper tip. 42. Lift cylinders for ripper.



RIPPER CONTROL LEVER AND LINKAGE

33. Lever for ripper control. 34. Linkage to pilot valve for ripper lift control.

The movement of lever (33) to the right or left controls the RAISE and LOWER operations of the ripper. If lever (33) is moved to the right, the ripper will LOWER. When the lever is moved to the left, the ripper will RAISE.

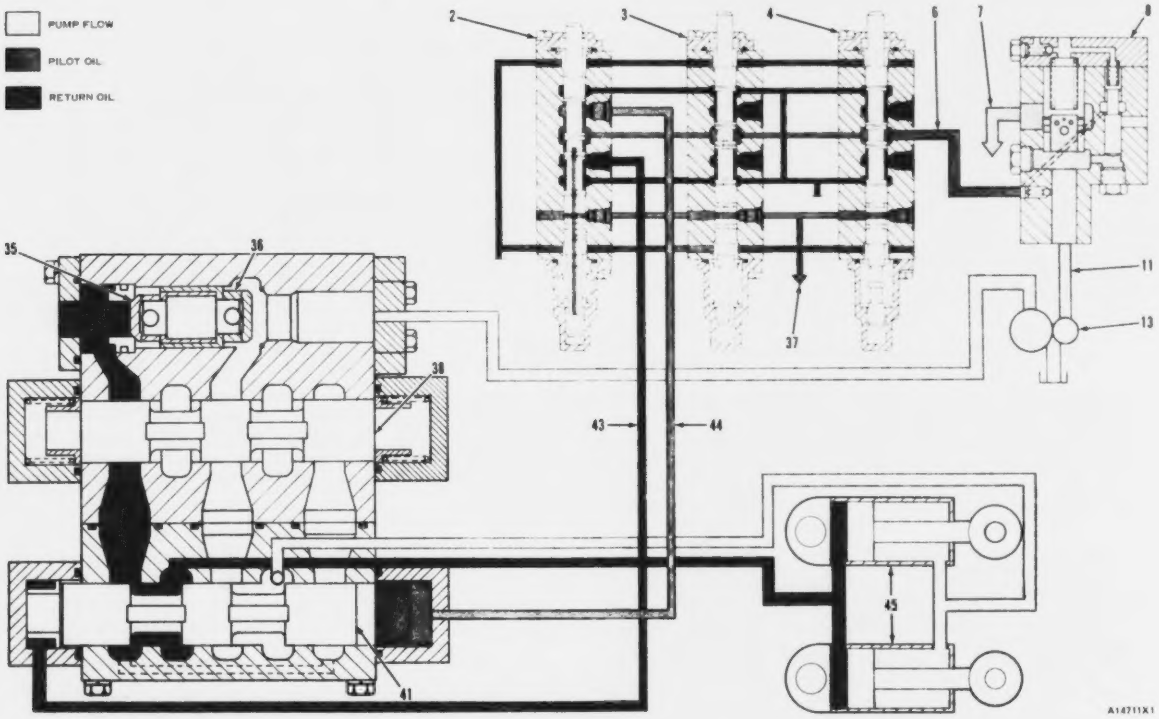
The pilot oil, from restrictor valve (8), is controlled by pilot valve (3). It is used to operate the valve spool for main control of the ripper lift circuit.

When lever (33) is moved to the left, linkage (34) pushes the spool of pilot valve (3) into the body. This opens a passage that lets pilot oil go through line (40) to the end of spool (38). This pressure oil moves spool (38) and opens a passage for pump flow and pressure to the rod end of the ripper lift cylinders (42).

NOTE: On the 183 and 193 Hydraulic Controls, pressure oil from the pump to the rod end of the cylinders will raise the ripper. On the 173 Hydraulic Control, pressure oil from the pump to the rod end of the cylinder will lower the ripper.

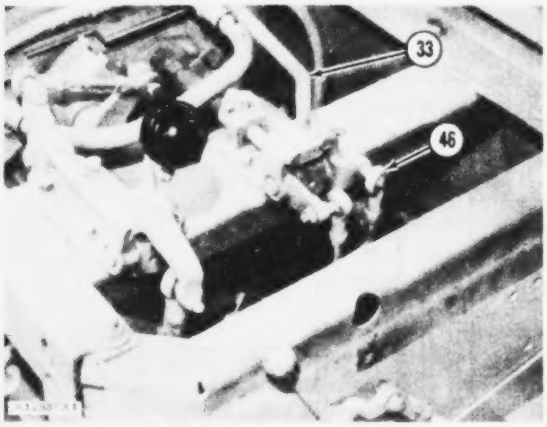
When the pilot valve for ripper lift is actuated, the pilot pressure oil goes down through the spool and out through line (37) to the main control valve for dozer lift. When this pressure oil gets to the main control valve, it causes shuttle valve (15) to move. Movement of the shuttle valve lets pilot pressure oil in behind flow control valve (17). This pressure oil keeps the flow control valve from moving and it becomes a dump valve for main relief valve (16).

RIPPER TIP CIRCUIT



PILOT SYSTEM
(Shown with Ripper Tip Valve Actuated)

2. Pilot valve for ripper tip control. 3. Pilot valve for ripper lift control. 4. Pilot valve for dozer tilt control. 6. Line for pilot oil from restrictor valve (8) to pilot valves. 7. Line for pressure oil from restrictor valve (8) to dozer tilt valve (10). 8. Restrictor valve. 11. Line for oil supply from small section of pump (13) to restrictor valve (8). 13. Hydraulic pump. 35. Make-up valve for ripper circuits. 36. Load check valve for ripper circuits. 37. Line for pilot oil to main control valve for dozer lift. 38. Main control valve spool for ripper lift. 41. Main control valve spool for ripper tip. 43. Line for pilot oil pressure to valve spool for ripper tip. 44. Line for pilot oil pressure to valve spool for ripper tip. 45. Tip cylinders for ripper tip.



RIPPER CONTROL LEVER AND LINKAGE

33. Lever for ripper control. 46. Linkage to pilot valve for ripper tip control.

The operation of the ripper tip circuit is the same as for the ripper lift circuit. Pilot oil pressure from the restrictor valve is controlled by pilot valve (2). Movement of the spool in pilot valve (2) opens a passage that lets pilot oil go through line (44) to one end of the tip spool in the control valve for the ripper. This pressure moves the tip spool and opens passages to the rod end and head end of the tip cylinders. With pilot pressure oil in line (44), main system pressure will be at the rod end of tip cylinders (45). This means the control is in the SHANK OUT position.

NOTE: The variable pitch ripper is available only on the D8 and D9 Tractors.

If the spool in pilot valve (2) is moved in the opposite direction, pilot oil, through line (43), will move the main spool in the opposite direction and the ripper will be in the SHANK IN position.

When the pilot valve for ripper tip is operated, the pilot pressure goes down through the spool and out through line (37) to the main control valve for dozer lift. When this pressure oil gets to the control valve, it causes shuttle valve (15) to move. Movement of the shuttle valve lets pilot pressure oil in behind flow control valve (17). This pressure keeps the flow control valve from moving and it becomes a dump valve for the pilot operated main relief valve (16).

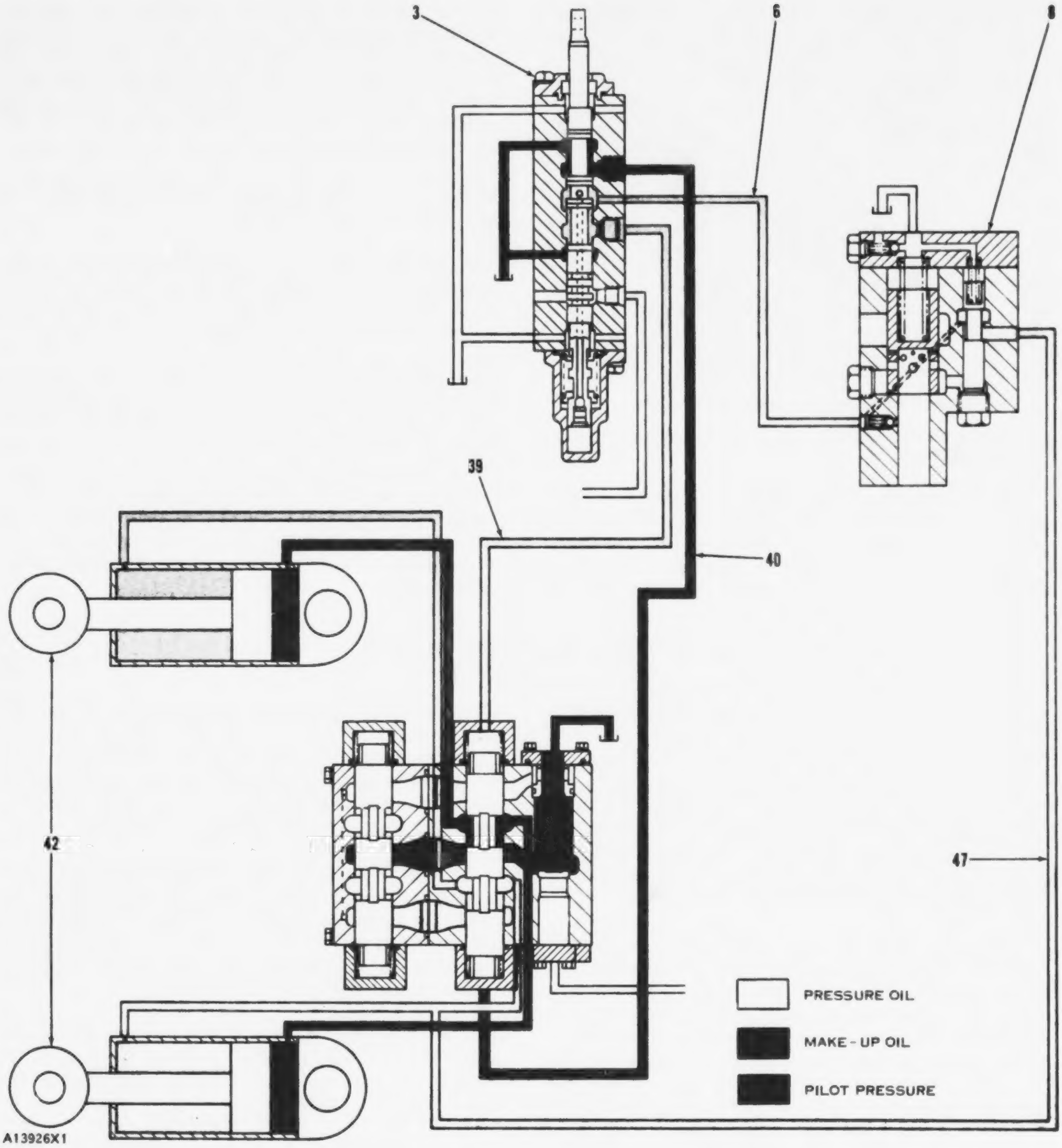
RIPPER LOWER WITH ENGINE NOT RUNNING

The ripper can be lowered when the engine is not running. When the lever for ripper control is pushed to the LOWER position, a passage is opened that lets pilot oil pressure go to the end of the valve spool for ripper lift. When the engine is running, this is done with pilot pressure oil. When the engine is not running it is done with oil pressure from the rod end of the cylinders (42) for ripper lift (head ends on the D7 Tractor).

When the spool in pilot valve (3) is moved to LOWER, a passage is opened that lets pressure oil from the lift cylinders activate the main control valve. This pressure oil is caused by the weight of the ripper. On the D8 and D9 Tractors the pressure comes from the rod end of the cylinders. On the D7 Tractor it comes from the head end. This pressure goes through line (47) to the restrictor valve, through a passage in the valve to line (6) which takes it to the pilot valve. From the pilot valve, through line (39), the action is the same as when the engine is running. At the main control valve, the spool for ripper lift has been moved in the same way as if the engine was running.

The oil that is not needed in the pilot circuit is sent to the head end of the cylinder through the make-up valve. Any additional oil that is needed to fill the head end is taken from the tank. Once the ripper is on the ground, the control lever can be moved back to the HOLD position.

NOTE: As the ripper moves down, it can be stopped by bringing the control lever back to HOLD. It can be started again by pushing the control lever to LOWER.


3
6
8
39
40
42
47
PRESSURE OIL
MAKE - UP OIL
PILOT PRESSURE
A13926X1

SCHEMATIC OF RIPPER LOWER CIRCUIT
WHEN ENGINE IS NOT RUNNING

3. Pilot valve for ripper lift control. **6.** Line for pilot oil from restrictor valve (8) to pilot valves. **8.** Restrictor valve. **39.** Line for pilot oil pressure to valve spool for ripper lift. **40.** Line for pilot oil pressure to valve spool for ripper lift. **42.** Lift cylinders for ripper. **47.** Line for pressure oil from lift cylinder on ripper to restrictor valve.

TROUBLESHOOTING

PROBLEM 1: Noise from the pump, cylinder movement is not smooth and regular and a sample of oil from the tank has air bubbles in it.

The probable cause of these problems is air in the system. The noise from the pump is caused by cavitation (air bubbles at the inlet side); the cylinder that does not work smoothly is caused by the compression of air; and the bubbles in the oil are caused by a leak in the system.

1. Check the hose and connections between the tank and the pump for leaks. If oil can leak out when the machine is setting idle, air can leak in when the pump is working.
2. Check the level of oil in the hydraulic tank. If the level of the oil is below the return line, air can get into the oil.
3. Another cause of air in the oil is low oil viscosity. Make reference to the respective machine LUBRICATION & MAINTENANCE GUIDE.

PROBLEM 2: The oil in the system gets too hot.

There are many factors that can cause heat in the hydraulic system. The common causes are; low oil level in the tank, a short rapid duty cycle, a pressure setting on the relief valve that is too low, a restriction in a line that causes an orifice effect.

1. Low oil level in the hydraulic tank. Check the oil level and if it is low add oil to the full mark. Check the lines, hoses, connections, valves and cylinders for leaks.
2. If the duty cycle of the machine is short and fast, the temperature of the oil can become high. When oil temperature goes above 210° F (98.8° C) it destroys oil seals in the system.
3. A low setting for relief valve opening will also cause high temperature in the system oil. This can be corrected by an adjustment to the relief valve that gives an opening pressure according to specification.
4. A more difficult cause to find is a restriction in an oil line. A restriction in the pump supply line will reduce the flow of oil to the pump and cause the pump to become very hot. A restriction in a line that is between the pump and the implements will cause a reduction in efficiency and high oil temperature. Removal of the restriction will normally remove the problem.

PROBLEM 3: Oil delivery by the pump is not according to specification.

There are many reasons why a pump is not delivering oil. Problem 2 shows that a restriction in the supply line to the pump will reduce the flow of oil. If the quantity of oil in the system is low, the pump delivery will be low. Low oil level in the system can cause aeration (air in the oil). Aeration in turn can cause cavitation at the pump. This will cause less output from the pump. If the viscosity of the oil is too high, there will be a decrease in the flow of oil from the pump. A badly worn pump or one that has not been correctly assembled will also cause less output flow.

1. Check the supply line to the pump for a restriction. Check the tank to be sure there is not a restriction in the supply line to the pump.
2. Check the level of the oil in the hydraulic tank. Make reference to the respective machine LUBRICATION & MAINTENANCE GUIDE.
3. Check the type of oil being used in the system. Make reference to the respective machine LUBRICATION & MAINTENANCE GUIDE.
4. Remove and inspect the pump. Check it for wear and be sure that it is assembled correctly.

PROBLEM 4: Oil pressure in the system is too low.

This problem is normally caused by leakage in the system, the opening pressure of the relief valve is too low, or a bad pump.

1. Carefully check the system for leakage. Remember that leakage inside a control valve can not be easily seen.
2. Check the opening pressures of the two relief valves in this system.
3. Remove and inspect the pump for damage and correct assembly.

NOTE: Low oil flow from the pump will cause low oil pressure in the system. See Problem 3.

PROBLEM 5: Loss of efficiency in the implement circuits. (Slow cylinder movement and loss of pressure).

The probable cause for this problem is normally the same as the causes for Problems 3 and 4. Low oil output from the pump, leakage in the system and the opening pressure of the relief valve is too low. Check Problems 3 and 4 for solutions to this problem. Also check all control linkage for free movement and correct adjustment for full travel of control valve spools.

PROBLEM 6: Cylinder drift that is more than specification.

For the cause of this problem, see the DRIFT TESTS for the different circuits.

PROBLEM 7: Slow (or loss of) movement in the tilt or ripper circuits.

If this problem is not in the dozer lift circuit, the cause is probably in the pilot system. The dozer lift control is manually operated through linkage from the dozer lever. The other implements (tilt and ripper) are operated by moving their control valves with pilot oil.

1. Check the pressure of the pilot system. See TESTS OF SETTINGS FOR RELIEF VALVES. Pilot pressure is caused at the restrictor valve by flow from the small section of the pump.

NOTE: Remember that pilot pressure can be as high as the relief valve pressure for the tilt circuit. It must not be less than 100 psi (7.0 kg/cm^2).

2. Check the output from the small section of the pump (See Problem 3).
3. Check the restrictor valve for free movement of spools, weak or broken spring or not enough shims.

PROBLEM 8: Ripper movement is very slow with no down pressure in either the lift or tip circuits or both.

When one of the pilot valves for the ripper circuits is activated, pilot oil is sent through the shuttle valve, in the dozer control valve, to the chamber in back of the dump valve for main relief. This causes the flow control characteristic of the dump valve to stop and the valve now becomes a pilot operated relief valve.

1. Activate the tilt circuit. If the tilt cylinder moves as expected, pilot system pressure is correct.
2. If the problem is common to both the ripper tip and ripper lift, then the cause is in the line between the pilot valves and the shuttle valve or in the shuttle valve. Check the pilot line for restriction or the shuttle valve for damage.

TESTING AND ADJUSTING

During a diagnosis of the hydraulic system, remember that correct oil flow and pressure are necessary for correct operation. The output of the pump (pump flow) increases with an increase in engine rpm and decreases when engine rpm is decreased. Oil pressure is caused by resistance to the flow of oil.

Visual checks and measurements are the first step when troubleshooting a possible problem. Then do the Operation Checks and last the Instrument Tests.

Use the 5S5123 Hydraulic Test Group, a stop watch, a magnet and an inch (mm) ruler for basic tests to measure:

1. The opening pressure of the relief valve for the main system and the relief valve for the tilt circuit: Relief valve pressures that are too low will cause a decrease in the lifting and dozing efficiency of the machine. Opening pressures that are too high will cause a decrease in the life of hoses and components.
2. Drift rates in the lift and tilt circuits: Circuit drift is caused by leakage past cylinder pistons, O-ring seals in the control valves, check valves or make-up valves that do not seal correctly or bad adjustment or fit in the control valves.
3. Cycle times in the lift and tilt circuits: Cycle times that are longer than shown in the charts are the result of leakage, pump wear and/or pump speed (rpm).

The tilt and lift circuits are connected in a modified series circuit for the flow from the small section of the pump. The lift and ripper circuits are connected in parallel for flow from the large section of the pump. The output of the two sections of the pump flow together in the control valve for blade lift. The relief valve for main system pressure is common to both the blade lift circuit and the ripper. The tilt circuit has a separate relief valve. Each circuit has a load check valve to prevent cylinder drift during valve spool movement. The blade lift and ripper circuits have make-up valves.

⚠ WARNING: When testing or making an adjustment to the hydraulic system, move the machine to a location away from other moving machines. The operator must be sure that other personnel are not near the machine when the engine is running and he is making tests.

VISUAL CHECKS

A visual inspection of the system is the first step when troubleshooting a problem. Make the inspection with the engine turned off and the implements lowered to the ground.

1. Check the level of oil in the tank. Slowly loosen the tank filler cap and release the pressure before removal of the cap.
2. Remove the filter element and check it for material that would give an indication of damage to a component.
3. Inspect all lines and connections for damage or leaks.
4. Inspect control linkage for bent, broken or damaged components.

OPERATING CHECKS

The operating checks can be used to find leakage in the system. They can also be used to find a valve or pump that is not working correctly. The speed of rod movement when the cylinders are working can be used to check the condition of the cylinders and the pump.

Raise and lower the blade and ripper several times. Operate the tilt control valve until the tilt cylinder is fully extended and retracted several times.

1. Watch the cylinders as they are extended and retracted. Movement must be smooth and regular.
2. Check for noise coming from the pump.
3. Check for the sound of the relief valve opening. The opening pressures of the relief valves are given in a chart in the subject, TESTS OF SETTINGS FOR RELIEF VALVES.

LIFT AND TILT CIRCUIT SPEEDS

The oil in the system must be SAE 10 and at a recommended temperature of 150 ± 5° F (65° C) to get correct results. All speed tests are made with the engine rpm at high idle.

System speeds that are the same as those given in the chart, is an indication that the circuit operation is normal. The relief valve should be tested to be sure that the opening pressure of each is correct. (See chart for settings).

If only one of the circuit speeds is slow, check that circuit for cylinder drift.

TILT CIRCUIT SPEED TEST	SPEED IN SECONDS		
	173	183	193
Time needed to move the tilt cylinder rod from fully retracted to fully extended (Blade tilt left to blade tilt right).	2.2	4.7	4.3
Time needed to move the tilt cylinder rod from fully extended to fully retracted (Blade tilt right to blade tilt left).	1.7	3.9	3.5

LIFT CIRCUIT SPEED TEST	SPEED IN SECONDS		
	173	183	193
Time needed to raise the blade from ground level to maximum height.	3.0	2.9	4.8

RIPPER CIRCUITS SPEED TEST	SPEED IN SECONDS		
	173	183	193
Time needed to raise the ripper from fully extended to fully extracted.	4.8	5.3	7.2
Time needed to move the tip cylinder rod from fully retracted to fully extended.		4.4	6.4

If the speed tests on all circuits are slow, check the pump for efficiency. (See CHECKING PUMP EFFICIENCY). Also check the relief valves for leakage or low pressure settings.

HYDRAULIC SYSTEM TEST PROCEDURES

Drift Tests for Lift Circuit

LIFT CYLINDER DRIFT			
Oil Temperature	100°F (38°C)	135°F (55°C)	175°F (78°C)
Must not move more than 1.5 in. (12.7 mm) in:	5 minutes	3.3 minutes	1.7 minutes

TEST NO. 1: Raise the front of the machine off the ground by lowering a level blade. Put the control lever in HOLD position. Shut off the engine and watch the lift cylinder rods for movement.

TEST NO. 2: Raise the front of the machine off the ground by lowering a level blade. Shut off the engine. Hold the lift control lever in LOWER position. Watch the lift cylinder rods for movement.

TEST NO. 3: Raise the blade off the ground. Put the control lever in HOLD position. Shut off the engine and watch the lift cylinder rods for movement.

TEST NO. 4: Raise the blade off the ground. Shut off the engine. Hold the lift control lever in RAISE position. Watch the lift cylinder rods for movement.

TEST RESULTS	MOST PROBABLE CAUSES
Drifting occurs in Tests No.1 and No.2	Lift circuit make-up valve (head ends) leaking.
Drifting occurs in Tests No.3 and No.4	Lift circuit make-up valve (rod ends) leaking.
Drifting occurs in Tests No.2 No.3 and No.4	Leakage between pistons and cylinders. Bad piston valves in cylinders.
Drifting occurs in Tests No.2 and No.4	Lift circuit check valve leaking. (Leakage between valve and seat and/or seat and body.)
NOTE: Remember that an O-ring seal failure in the circuit will have the same effect as a major component failure.	

Drift Test For Tilt Circuit

TILT CYLINDER DRIFT			
Oil Temperature	100°F (38°C)	135°F (55°C)	175°F (78°C)
Must not move more than .44 in. (11.2 mm) in:	5.0 minutes	3.3 minutes	1.7 minutes

TEST NO. 1: Put the blade flat on the ground. Raise the front of the machine off the ground by lowering the right side of the blade (TILT RIGHT). Put the tilt circuit in HOLD position. Shut off engine and watch the tilt cylinder rod for movement.

TEST NO. 2: Put the blade flat on the ground. Raise the front of the machine off the ground by lowering the right side of the blade (TILT RIGHT). Shut off the engine. Put the tilt circuit in TILT RIGHT position. Watch the tilt cylinder rod for movement.

TEST NO. 3: Put the blade flat on the ground. Raise the front of the machine off the ground by lowering the left side of the blade (TILT LEFT). Put the tilt circuit in HOLD position. Shut off the engine and watch the tilt cylinder rod for movement.

TEST NO. 4: Put the blade flat on the ground. Raise the front of the machine off the ground by lowering the left side of the blade (TILT LEFT). Shut off the engine. Put the tilt circuit in TILT LEFT position. Watch the tilt cylinder rod for movement.

TEST RESULTS	MOST PROBABLE CAUSES
Drifting occurs in Tests No.1 and No.3	Leakage between piston and cylinder Leakage between tilt circuit valve spool and body.
Drifting occurs in Tests No.2 and No.4	Tilt circuit check valve leaking. (Leakage between valve and seat and/or seat and body.)
NOTE: Remember that an O-ring seal failure in the circuit will have the same effect as a major component failure.	

Drift Tests for Ripper Lift Circuit

RIPPER LIFT CYLINDER DRIFT			
Oil Temperature	100°F (38°C)	135°F (55°C)	175°F (78°C)
Must not move more than .38 in. (9.6 mm) in:	5 minutes	3.3 minutes	1.7 minutes

TEST NO. 1. Raise the rear of the machine off the ground by lowering the ripper. Put the ripper control lever in HOLD position. Shut off the engine and watch the ripper cylinder rods for movement.

TEST NO. 2: Raise the rear of the machine off the ground by lowering the ripper. Shut off the engine. Hold the ripper control lever in LOWER position. Watch the ripper cylinder rods for movement.

TEST NO. 3: Raise the ripper off the ground. Put the control lever in HOLD position. Shut off the engine and watch the ripper cylinder rods for movement.

TEST NO. 4: Raise the ripper off the ground. Shut off the engine. Hold the ripper control lever in RAISE position. Watch the ripper cylinder rods for movement.

TEST RESULTS	MOST PROBABLE CAUSES
Drifting occurs in Tests No.1 and No.3.	Leakage between piston and cylinder. Leakage between ripper circuit valve spool and body.
Drifting occurs in Tests No.2 and No.4.	Ripper circuit check valve leaking. (Leakage between valve and seat and/or seat and body.)
NOTE: Remember that an O-ring seal failure in the circuit will have the same effect as a major component failure.	

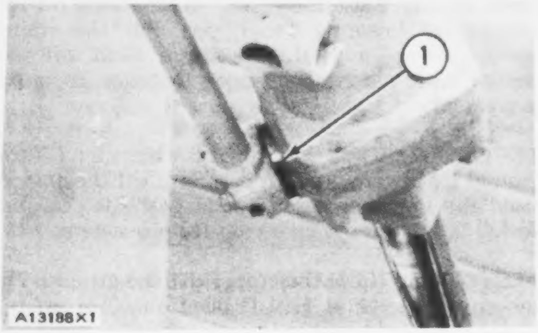
Tests of Settings for Relief Valves

RELIEF VALVE SETTINGS psi (kg/cm^2)				
	TILT CIRCUIT	DOZER CIRCUIT	RIPPER LIFT CIRCUIT	RIPPER TIP CIRCUIT
173	2450 ± 75 (172 ± 5.3)	2250 ± 75 (158.2 ± 5.3)	2250 ± 75 (158.2 ± 5.3)	2250 ± 75 (158.2 ± 5.3)
183	2500 ± 25 (175.8 ± 1.8)	2400 ± 75 (168.8 ± 5.3)	2400 ± 75 (168.8 ± 5.3)	2400 ± 75 (168.8 ± 5.3)
193	2400 ± 75 (168.8 ± 5.3)	2250 ± 75 (158.2 ± 5.3)	2250 ± 75 (158.2 ± 5.3)	2250 ± 75 (158.2 ± 5.3)

Move the machine to a location where the blade can be lowered and will sit level on the ground (floor). Get the hydraulic oil to operating temperature. Turn off the engine. Move the control lever for the dozer to each operation position several times to take the pressure out of the lines.

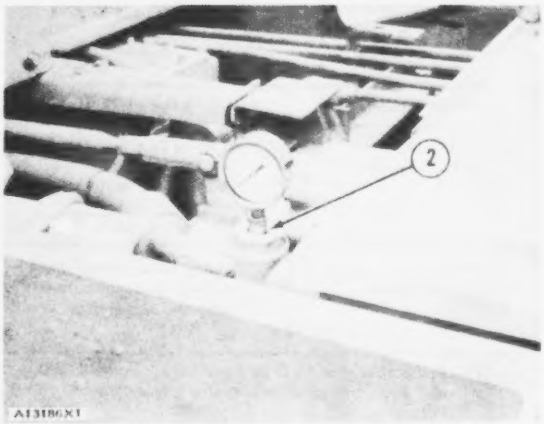
Dozer Circuit

1. Clean the oil and dirt off of connections and fittings.
2. Install a 9S8093 or 5H4020 Blocking Plate Assembly (1) in the rod end line for each of the dozer cylinders. Install it as close to the cylinder as possible.
3. Install a 0 to 4000 psi (0 to 281.0 kg/cm^2) pressure gauge in pressure tap (2).
4. Start the engine and run it at high idle speed to get full flow from the pump.



BLOCKING PLATE ASSEMBLY

1. Blocking plate assembly.



PRESSURE TAP LOCATION

2. Pressure tap.

5. Move the blade control to RAISE and LOWER positions to get maximum system pressure. Check for circuit speed.

NOTE: Do not keep the system at relief pressure for more than ten seconds. If more time is needed, wait one minute and do Step 5 again.

6. Inspect all lines, connections and fittings for leaks.

7. Relief valve pressure must be as shown in Relief Valve Setting Chart.

8. Turn off the engine and move the blade control lever to all positions several times to release pressures.

9. Remove the Blocking Plate Assemblies and connect lines to cylinders.

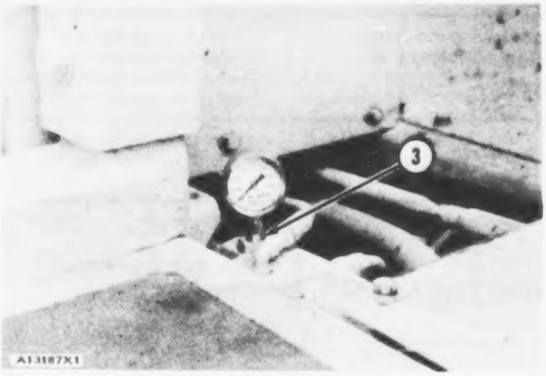
10. Check the oil level in the hydraulic tank and add oil if necessary. Make reference to the respective machine's LUBRICATION & MAINTENANCE GUIDE.

NOTE: If the machine is equipped with a ripper, the main relief valve setting can be checked by using the procedure for the ripper circuit.

Tilt and Tilt Pilot Circuits

1. Clean the oil and dirt off of connections and fittings.

2. Install a 0 to 4000 psi. (0 to 281.0 kg/cm^2) pressure gauge in pressure tap (3).



PRESSURE TAP LOCATION

3. Pressure tap.

3. Start the engine and run it at high idle to get full flow from the pump.

4. Move the blade control to RAISE position until blade is clear of the ground.

5. Move the tilt control lever to TILT LEFT and TILT RIGHT to get maximum system pressure. Check for circuit speed.

NOTE: Do not keep the system at relief pressure for more than ten seconds. If more time is needed, wait one minute and do Step 5 again.

6. Inspect all lines, connections, cylinder rod seals, and fittings for leaks.

7. Relief valve pressure must be as shown in the Relief Valve Setting Chart.

Ripper Lift and Ripper Lift Pilot Circuits

1. Clean the oil and dirt off of connections and fittings.

2. Install a 0 to 4000 psi (0 to 281.0 kg/cm^2) pressure gauge in pressure tap (2).

3. Start the engine and run it at high idle to get full flow from the pump.

4. Move the ripper control lever to RAISE and LOWER positions to get maximum system pressure. Check for ripper circuit speed.

NOTE: Do not keep the system at relief pressure for more than ten seconds. If more time is needed, wait one minute and do Step 4 again.

5. Inspect all lines, connections, cylinder rod seals and fittings for leaks.

6. Relief valve pressure must be as shown in chart.

Ripper Tip and Ripper Tip Pilot Circuits

1. Clean the oil and dirt off of connections and fittings.

2. Install a 0 to 4000 psi (0 to 281.0 kg/cm^2) pressure gauge in pressure tap (2).

3. Start the engine and run it at high idle to get full flow from the pump.

4. Move the ripper tip control lever to SHANK IN and SHANK OUT positions to get maximum system pressure. Check for ripper tip circuit speed.

NOTE: Do not keep the system at relief pressure for more than ten seconds. If more time is needed, wait one minute and do Step 4 again.

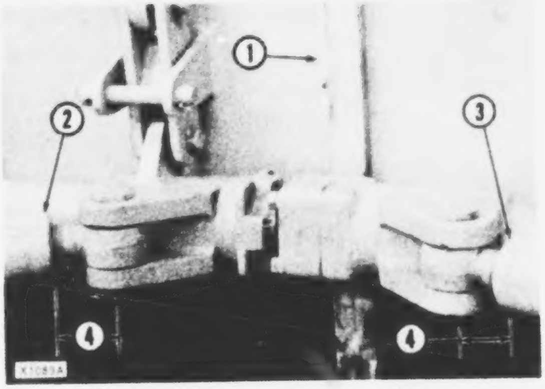
5. Inspect all lines, connections, cylinder rod seals and fittings for leaks.

6. Relief valve pressure must be as shown in the Relief Valve Setting Chart.

Additional tests can be made by checking the movement of the control valve spools and the cylinders when a circuit is activated. In all positions of every control valve, except the FLOAT position of the blade control, the spool must return freely to the HOLD position when the lever is released. The FLOAT position on the blade control valve has a detent and must be returned to HOLD manually. Movement of the cylinders when a circuit is activated must be smooth and regular.

PUSH ARM AND BRACE GROUP

On bulldozers equipped with the sliding center ball joint, minimum dimensions must be kept to be sure that the blade parts work smoothly. Install a 1.50 in. (38.1 mm) block (1) between the blade and cage on the ball joint. Make an adjustment to link assemblies (2) and (3) until block (1) is held tightly. Remove block (1) after making final adjustment. Dimensions (4) must be the same.



SLIDING CENTER BALL ADJUSTMENT

1. Block, 1.50 in. (38.1 mm) thick. 2. Link. 3. Link. 4. Dimensions that must be the same.

CHECKING PUMP EFFICIENCY

For any pump test, the pump flow, measured in gpm (lit/min) at 100 psi (7.0 kg/cm^2) will be larger than the pump flow at 1000 psi (70.3 kg/cm^2) at the same rpm.

The difference between the pump flow of two operating pressures is the flow loss.

Method of finding flow loss . . .

Pump flow at 100 psi	57.5 gpm (lit/min)*
Pump flow at 1000 psi	−52.0 gpm (lit/min)*
Flow loss	5.5 gpm (lit/min)*

Flow loss when expressed as a percent of pump flow is used as a measure of pump performance.

Example of finding percent of flow loss . . .

$$\left(\frac{\text{gpm flow loss}}{\text{Pump flow @ 100 psi}}\right) \times 100 = \text{Percent of flow loss}$$

$$\text{or} \quad \frac{{}^{*}5.5}{{}^{*}57.5} \times 100 = 9.5\%$$

If the percent of flow loss is more than 10%, on machine, (15% on the bench) pump performance is not good enough.

*Numbers in examples are for illustration and are not values for any specific pump or pump condition. See SPECIFICATIONS for pump flow of a new pump at 100 psi and 1000 psi.

Test On The Machine

Measure pump flow at 100 psi (7.0 kg/cm^2) and at 1000 psi (70.3 kg/cm^2) with engine running at:

D7G Tractor: 2000 rpm.
D8K Tractor: 1850 rpm.
D9H Tractor: 1800 rpm.

Formula I for all Tractors:

$$\left(\frac{\text{gpm @ 100 psi} - \text{gpm @ 1000 psi}}{\text{gpm @ 100 psi}}\right) \times 100 = \text{Percent of flow loss}$$

Test On The Bench (173 Hydraulic Control)

If the test bench can not be run at 1000 psi at a high rpm, do the first part of the test with the pump shaft rotation at 1040 rpm. Measure pump flow at 100 psi (7.0 kg/cm^2) and at 1000 psi (70.3 kg/cm^2). Then in order to measure the pump flow for the last part of the test, see SPECIFICATIONS for: Pump rpm at 100 psi with the engine at 2000 rpm.

Formula II for 173 Hydraulic Control:

$$\left(\frac{\text{gpm @ 100 psi} - \text{gpm @ 1000 psi}}{\text{Pump flow @ 100 psi @ 2000 rpm}}\right) \times 100 = \text{Percent of flow loss}$$

Test On The Bench (183 Hydraulic Control)

If the test bench can not be run at 1000 psi at a high rpm, do the first part of the test with the pump shaft rotation at 1360 rpm. Measure pump flow at 100 psi (7.0 kg/cm^2) and at 1000 psi (70.3 kg/cm^2). Then in order to measure the pump flow for the last part of the test, see SPECIFICATIONS for: Pump rpm at 100 psi with the engine at 1850 rpm.

Formula II for 183 Hydraulic Control:

$$\left(\frac{\text{gpm @ 100 psi} - \text{gpm @ 1000 psi}}{\text{Pump flow @ 100 psi @ 1850 rpm}}\right) \times 100 = \text{Percent of flow loss}$$

Test On The Bench (193 Hydraulic Control)

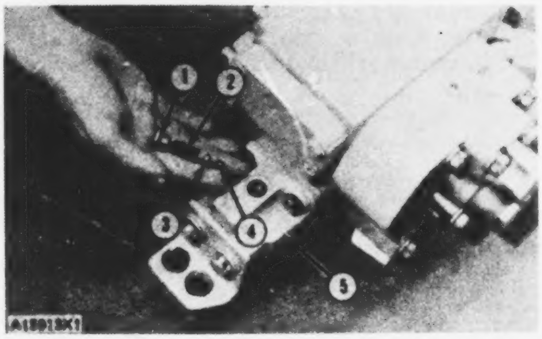
If the test bench can not be run at 1000 psi at a high rpm, do the first part of the test with the pump shaft rotation at 1190 rpm. Measure pump flow at 100 psi (7.0 kg/cm^2) and at 1000 psi (70.3 kg/cm^2). Then in order to measure the pump flow for the last part of the test, see SPECIFICATIONS for: Pump rpm at 100 psi with the engine at 1800 rpm.

Formula II for 193 Hydraulic Control:

$$\left(\frac{\text{gpm @ 100 psi} - \text{gpm @ 1000 psi}}{\text{Pump flow @ 100 psi @ 1800 rpm}}\right) \times 100 = \text{Percent of flow loss}$$

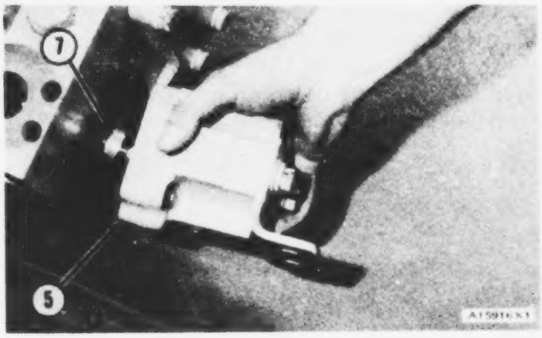
DOZER CONTROL VALVE

DISASSEMBLE DOZER CONTROL VALVE 15–5076

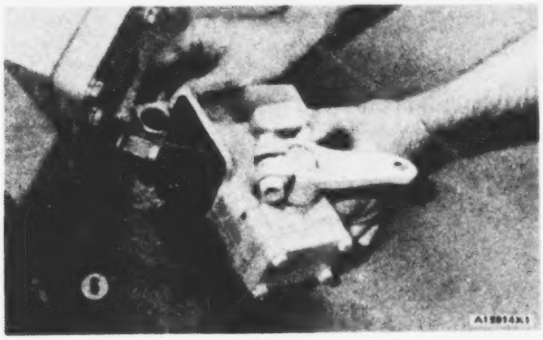


1. Remove detent plugs (1), springs (2), seats (3) and balls (4).

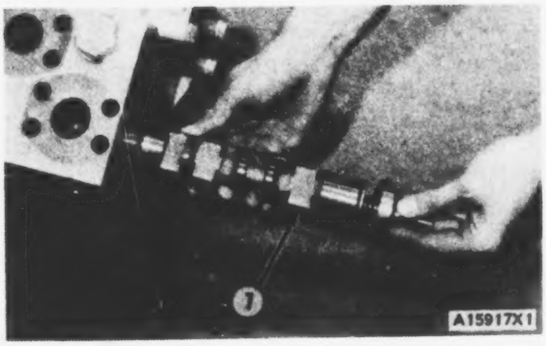
NOTE: There are two of these detents, 180° opposite of each other on housing (5).



2. Remove four bolts from housing (5) and remove housing from valve body.



3. Remove four bolts from control lever housing (6) and remove housing from valve body.



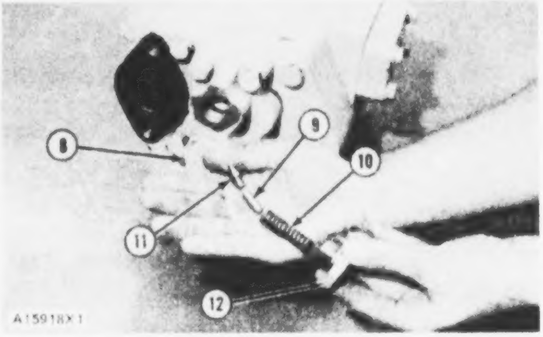
4. Carefully remove spool valve (7) from valve body.

NOTE: Spool must be removed from body through the detent end.

DOZER CONTROL VALVE

5. Remove two plugs, (8) and (12) from the valve body. Remove shims (in the plugs), pistons (9), springs (10) and valves (11) from the valve body.

NOTE: The plugs are marked with the pressure setting for the respective valve.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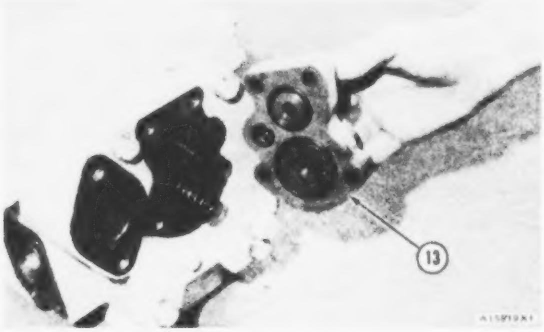
A15918X1

6. Remove four bolts from cover (13) and remove from valve body.

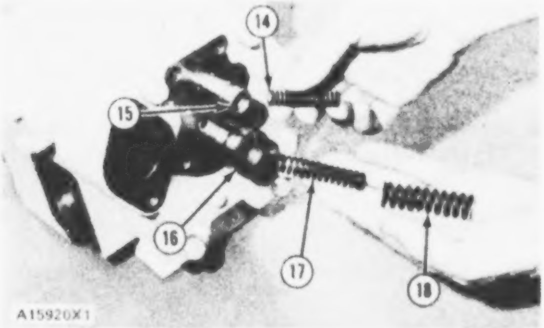

13
A15919X1

7. Remove spring (14) and valve (15).

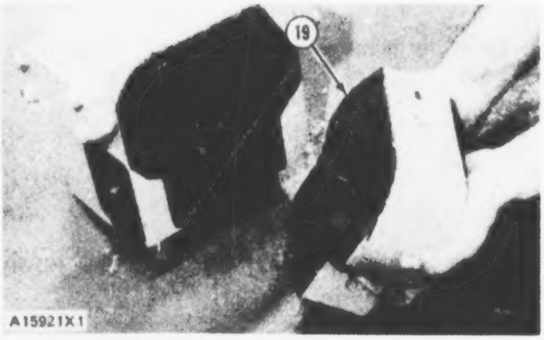
NOTE: This is the relief valve for the tilt circuit.

8. Remove springs (17) and (18) and valve (16).

NOTE: This is the dump valve for the main relief valve.


14
15
16
17
18
A15920X1

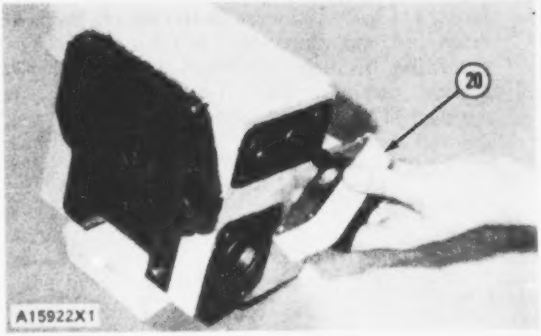
9. Remove four bolts from valve body (19) and remove body from valve group.


19
A15921X1

DOZER CONTROL VALVE

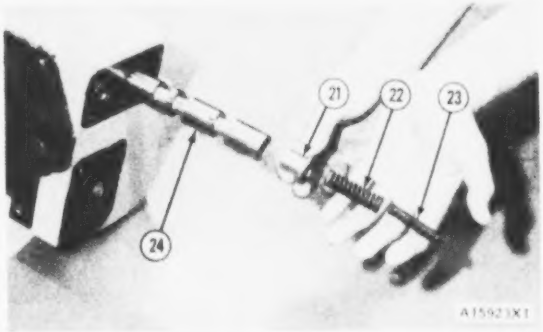
10. Remove four bolts from end cover (20) and remove cover from valve body.

NOTE: There is a small amount of tension on the spring behind the cover.



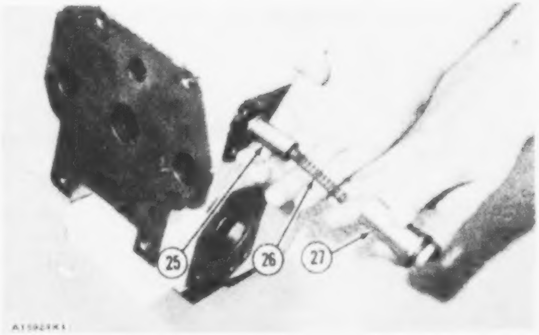
11. Remove springs (22) and (23), sleeve (21) and spool (24) from valve body.

NOTE: There are two more springs and a sleeve on the opposite end of spool (24). Remove these too.



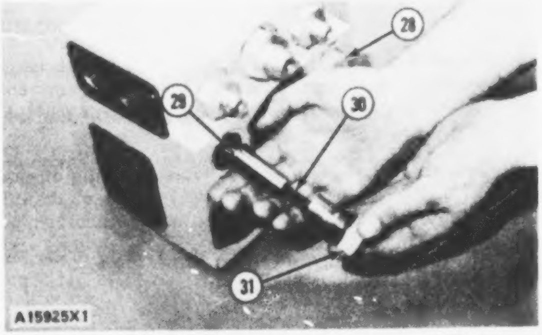
12. Remove sleeve (27), spring (26) and valve (25).

NOTE: There is another sleeve, spring and valve on the other side of the valve. Remove these too. These are make-up valves for the tilt circuit.



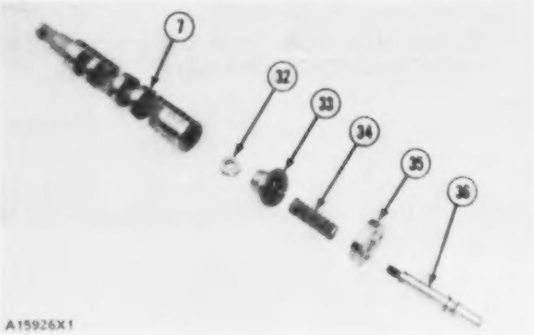
13. Remove plug (31), spring (30) and valve (29) from body of valve.

NOTE: This is a make-up valve for the dozer lift. The other make-up valve is located under plug (28). Remove it too.

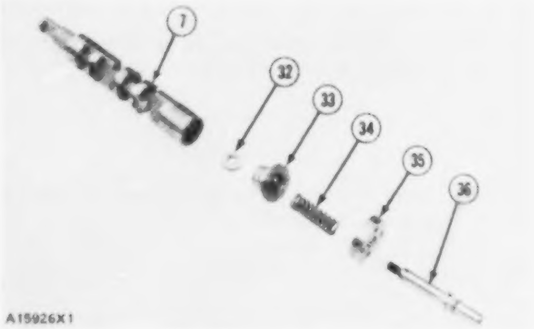


DOZER CONTROL VALVE

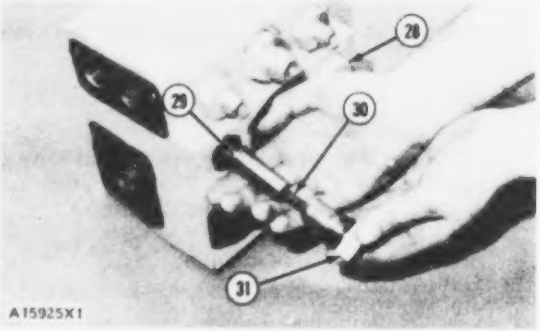
14. Use a 1/4 inch hex wrench to remove bolt (36) from the end of spool (7). Take the bolt out carefully because of force by spring (34) behind retainer (35). Remove retainer (35) spring (34) retainer (33) and washer (32) from the valve spool.



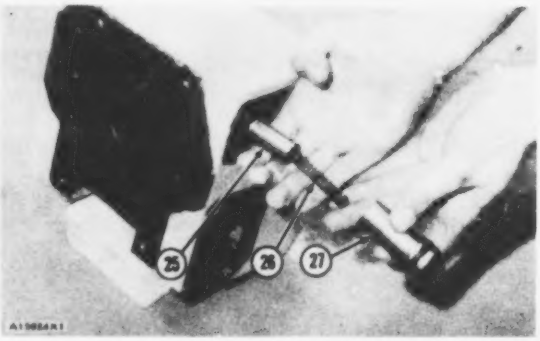
ASSEMBLE DOZER CONTROL VALVE 16–5076



1. Install washer (32), retainer (33), spring (34) and retainer (35) on spool (7). Put 9S3263 Thread Lock Compound on threads of bolt (36) and install into spool.



2. Install valve (29), spring (30) and plug (31) into valve body. Do this for two valves. Second valve is behind plug (28).

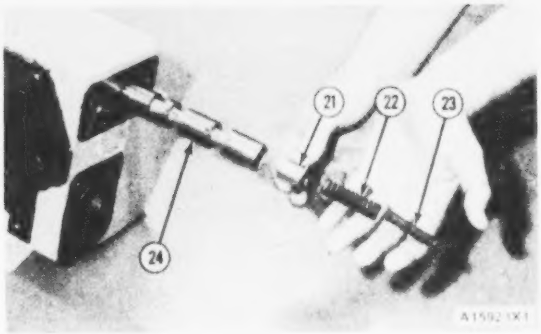


3. Install valve (25), spring (26) and sleeve (27). Be sure and use a new O-ring seal on the sleeve. Do this for two valves, one on each side of the body.

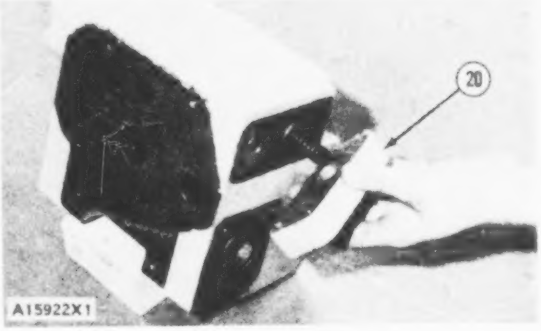
NOTE: Do not push the sleeve in even with the valve body.

DOZER CONTROL VALVE

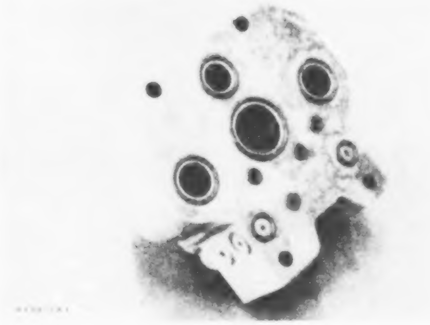
4. Install valve spool (24) for tilt circuit. Install retainer (21) and springs (22) and (23). Install O-ring in cover (20).



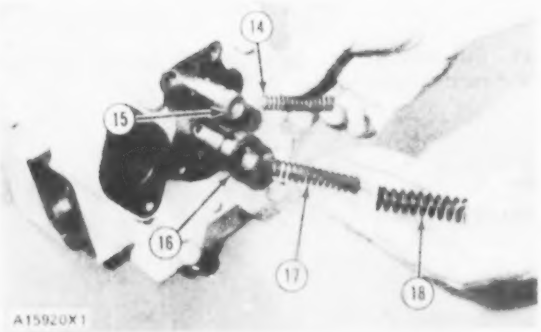
5. Use four bolts and assemble cover (20) to the valve body. This will cause the valve in Step 3 to become flush with the valve body.



6. Install O-rings in body and assemble to valve body with four bolts.

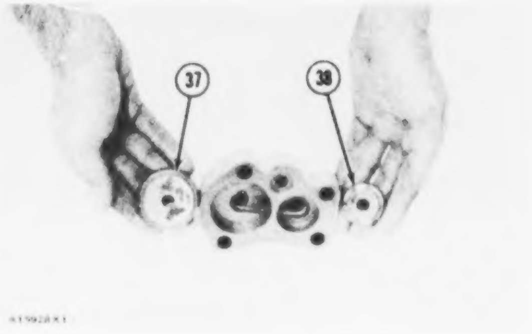


7. Put SAE oil on the valves. Install tilt relief valve (15) in the valve body. Install spring (14) in valve (15). Install dump valve (16) for the main relief valve in the valve body. Install springs (17) and (18) in the bore in dump valve (16).

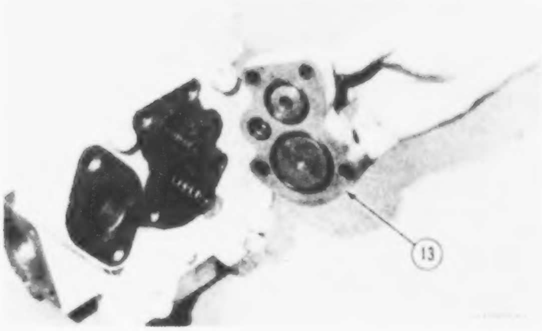


DOZER CONTROL VALVE

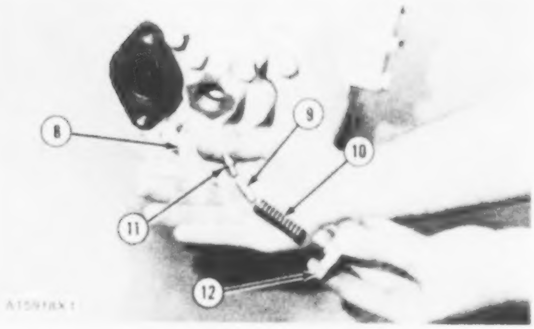
8. Install seal (38) for the pilot valve of the tilt relief valve and seal (37) for the pilot valve of the dozer relief valve. Install O-rings.



9. Install cover (13) with four bolts.

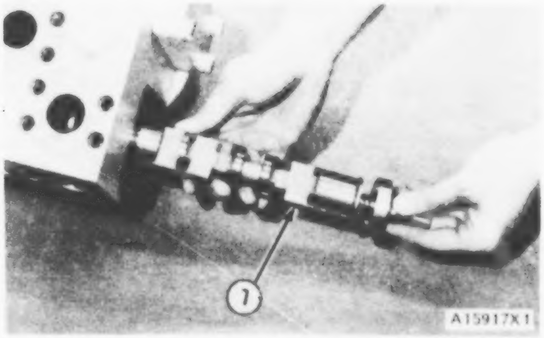


10. Install valve (11), piston (9), spring (10), shims and plug (12) in the bore for the tilt relief valve. The plug that is marked 2500 psi is the plug for the tilt relief valve. The plug marked 2400 psi is for the main relief valve. Install the valve, piston, spring, shims and plug (8) for the main relief valve.



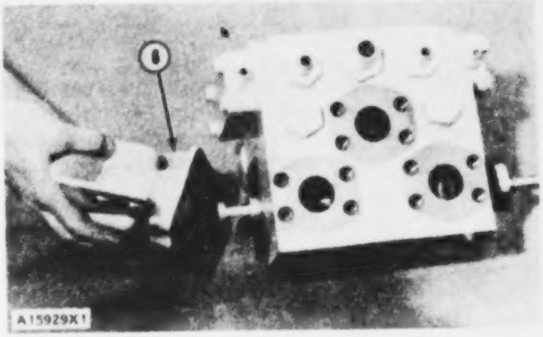
11. Put SAE 10 oil on spool (7). Install spool (7) in the valve body.

NOTE: Spool (7) for the control valve must be installed from the detent end.

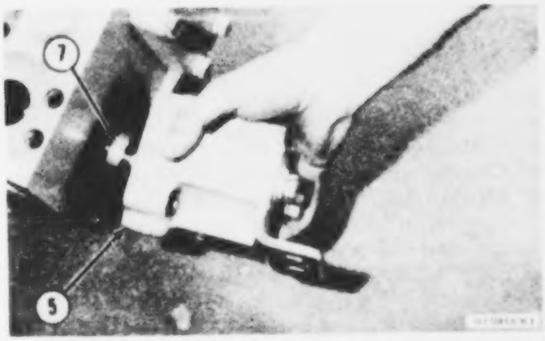


DOZER CONTROL VALVE

12. Install control lever housing (6) with four bolts. Be sure that the pawls on the lever engage the spool correctly.

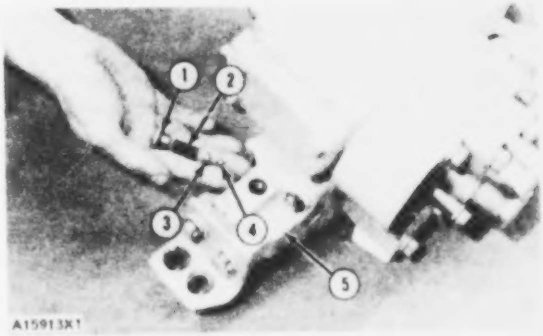


13. Install housing (5) over the end of spool (7). Fasten the housing to the valve body with four bolts.



14. Install ball detents (4), seat (3), spring (2) and plug (1) in housing (5). Be sure the O-ring seal is on plug (1) before installation.

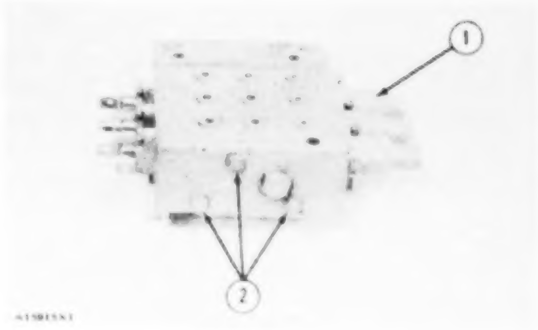
NOTE: There are two detents in housing (5). Do the procedure above for the other detent. The chamfer side of seat (3) goes down against ball (4).



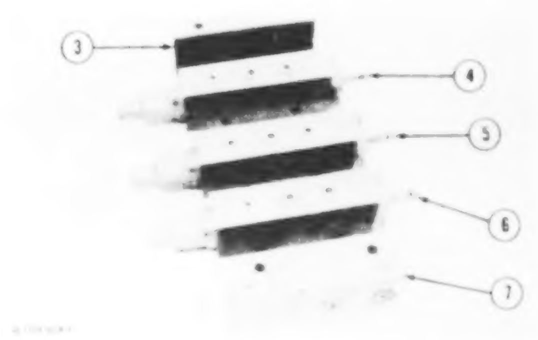
PILOT VALVE GROUP

DISASSEMBLE PILOT VALVE GROUP 15–5076

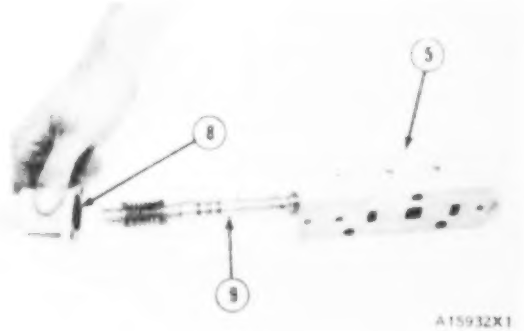
CAUTION: Before pilot valve group (1) is removed from the tractor, be sure that all the pressure in the system has been released. Disconnect the linkage and oil lines and remove the valve from the machine.



1. Remove three bolts (2) from valve body (1).

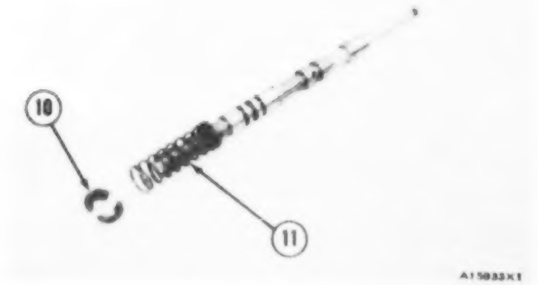


2. With the removal of bolts (2), the group can now be divided into pilot valve (6) for dozer tilt control, pilot valve (5) for ripper lift control, pilot valve (4) for ripper tip control and two end manifolds (3) and (7).



3. Remove the bolts that hold cover (8) on the end opposite the shaft end of the valve. Remove cover (8). Carefully remove spool (9) from body (5).

NOTE: The pilot valve in the illustration is used on the ripper lift or ripper tip control.

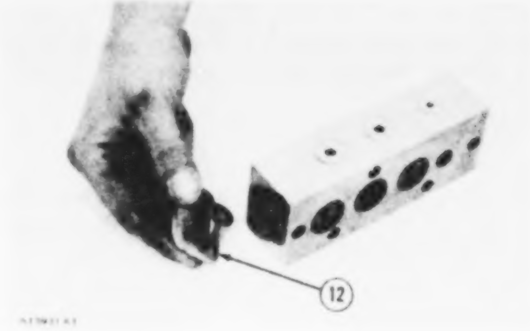


4. Carefully put spring (11) under compression. Remove retainers (10) from the valve spool. Slowly release the compression on spring (11).

PILOT VALVE GROUP

5. Remove two bolts holding cover (12) to body (5). Remove the cover.

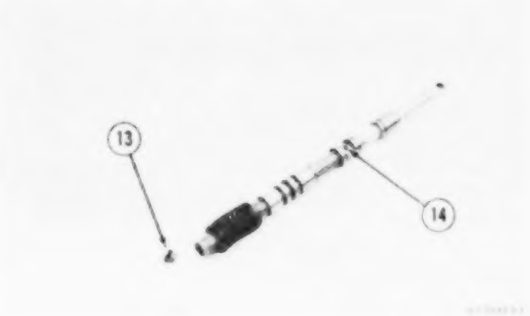
NOTE: There is a seal in cover (12). Check this seal for damage. If the seal is damaged, replace with a new one. Do not remove the seal if it is not damaged.



6. Remove plug (13) from the end of the spool. This will open a passage to the small hole (14). Check the seal on plug (13).

7. Do Steps 2 through 5 for the other two valves.

NOTE: There is no plug (Step 6) in the end of the spool for the control valve for dozer tilt.

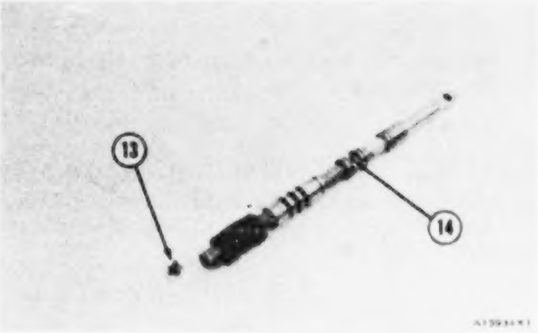


PILOT VALVE GROUP

ASSEMBLE PILOT VALVE GROUP 16–5076

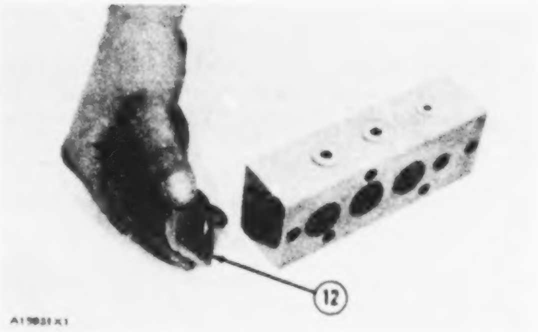
1. If necessary, install a new shaft seal in cover (12) on the shaft end of the valve.

2. Install a new O-ring on plug (13) and install in the end of spool (14). Be sure that the passage in spool (14) is open.



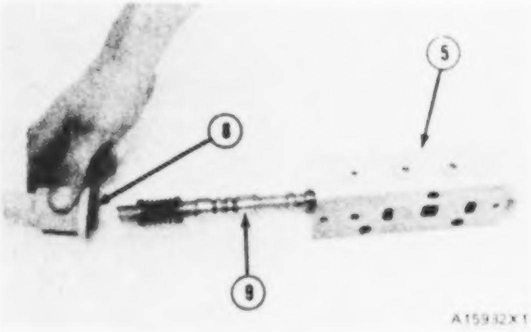
3. Put a new O-ring seal in the housing and install cover (12) on the end of the body.

4. Assemble the valve spool with retainers and spring.

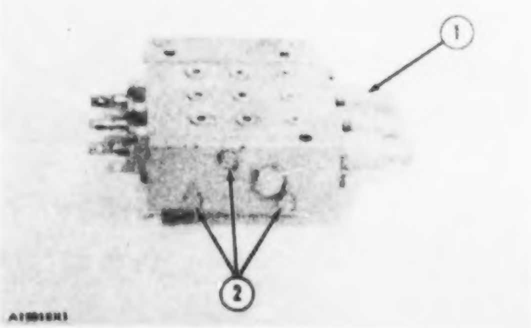


5. Install spool (9) in the valve body. Put the spool in oil for easier installation.

6. Do Steps 1 through 5 for the other valves.



7. Assemble the valves in correct order. Install three bolts (2) through the end manifold, the valves and the remaining manifold. Tighten bolts. Be sure not to cut an O-ring seal between each part.

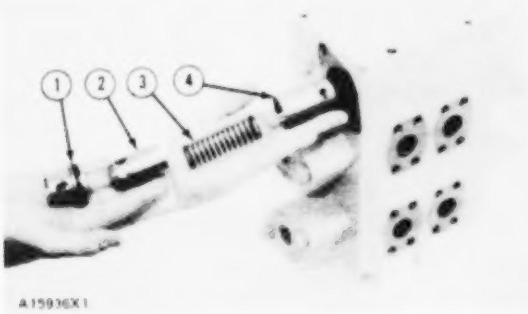


RIPPER CONTROL VALVE

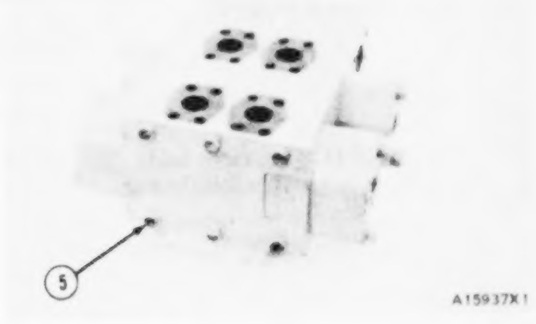
DISASSEMBLE RIPPER CONTROL VALVE 15–5076

CAUTION: Before the ripper control valve is removed from the machine, be sure that all of the pressure in the system has been released. Disconnect the pilot lines and pressure lines from the main system and remove the valve assembly.

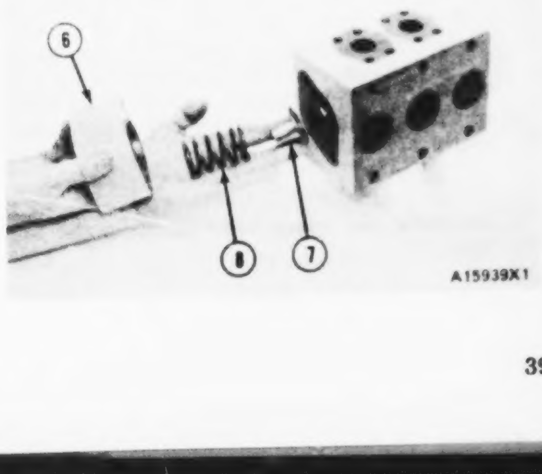
1. Remove valve seat (1), check valve (2), spring (3) and check valve (4).



2. Remove six bolts (5) and separate the valve groups.

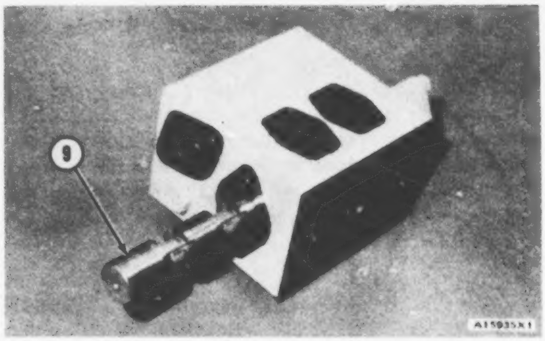


3. Remove two bolts from end housing (6). Remove these bolts carefully because of spring force behind the housing. Remove end housing (6), spring (8), and retainer (7).

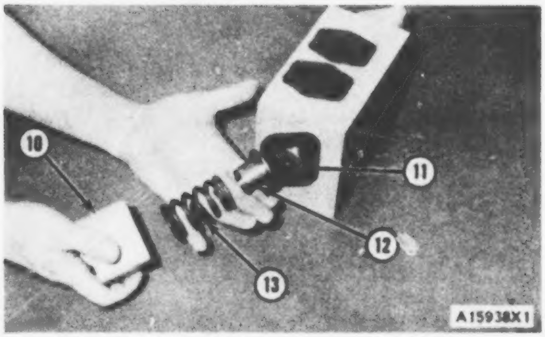


RIPPER CONTROL VALVE

4. Remove spool (9).

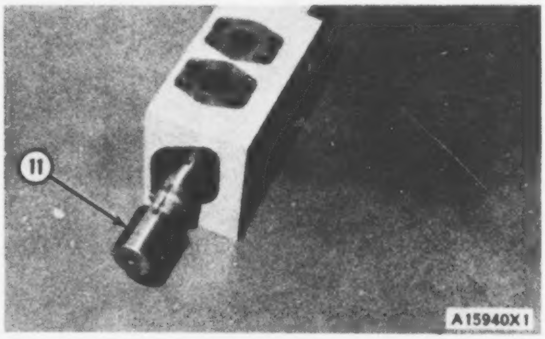


5. Do Steps 3 and 4 for the housing (10), spring (13), retainer (12) and spool (11) in the other valve group.



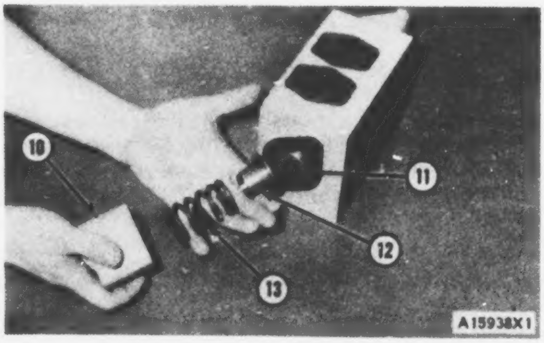
ASSEMBLE RIPPER CONTROL VALVE 16–5076

1. Install spool (11) in valve body. Put SAE 10 oil on the spool before installation.



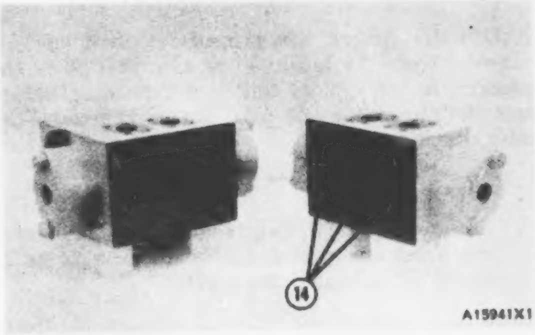
2. Put spring (13) in housing (10). Put retainer (12) over spring (13). Put the assembly in place over the end of spool (11). Install two bolts and tighten as much as possible by hand. Finish tighten bolts with a wrench. Be careful not to cut the O-ring seal between the housing and the valve body.

3. Assembie the other valve group in the same way.

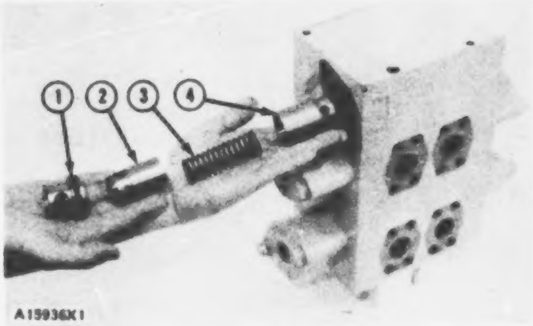


RIPPER CONTROL VALVE

4. Be sure that seals (14) are in the valve body. Put the two parts together and install the six bolts. Tighten the bolts. Be careful not to cut the O-rings between the valve bodies.



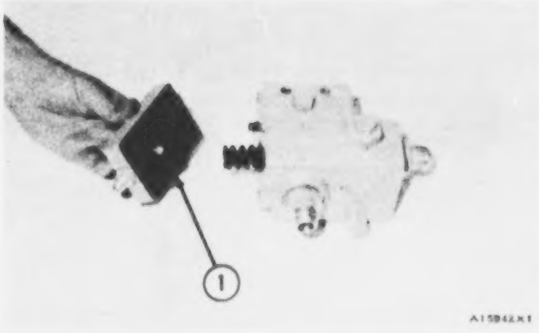
5. Install valve (4), spring (3) and valve (2) in the valve body. Make sure the O-ring seal on seat (1) is correctly installed. Carefully install seat (1) in the body.



PRESSURE CONTROL VALVE

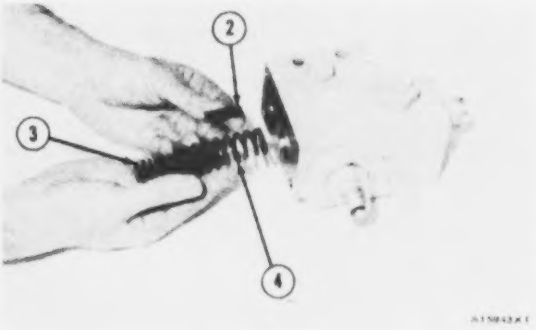
DISASSEMBLE PRESSURE CONTROL VALVE 15–5050

CAUTION: Before the pressure control valve is removed from the machine, be sure that all of the pressure in the system has been released. Disconnect the pump line and pilot lines, and remove the valve assembly.



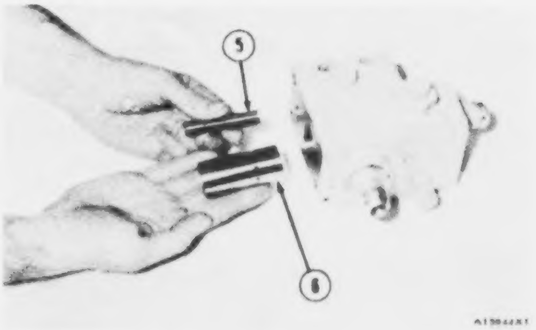
A15942X1

1. Remove cover (1) from valve body. Be careful when removing the cover, because there is spring force behind the cover.



A15943X1

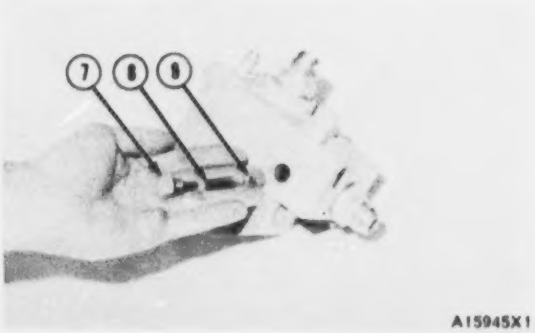
2. Remove three springs (2), (3) and (4) from the bores in the valve body.



A15944X1

3. Remove valves (5) and (6).

NOTE: The larger valve will have shims in it.



A15945X1

4. Remove plug (7), spring (8) and ball check (9).

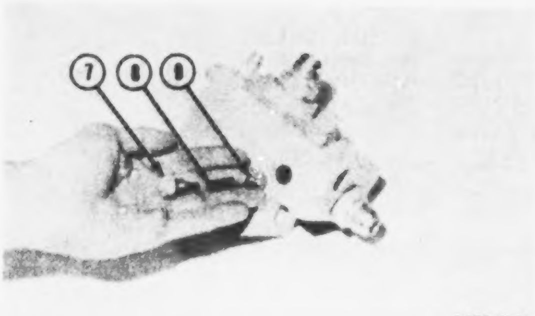
NOTE: There is another ball check valve in the cover. Remove it too. Keep the parts of the two ball checks separate. They must be installed in the same bore from which they were removed.

PRESSURE CONTROL VALVE

ASSEMBLE PRESSURE CONTROL VALVE 16–5050

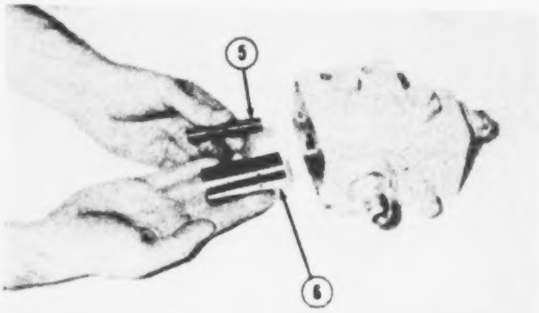
1. Install the ball check valves, springs and plugs.

NOTE: Be sure to get the ball checks back in their respective bores. These groups are different and can not be mixed.



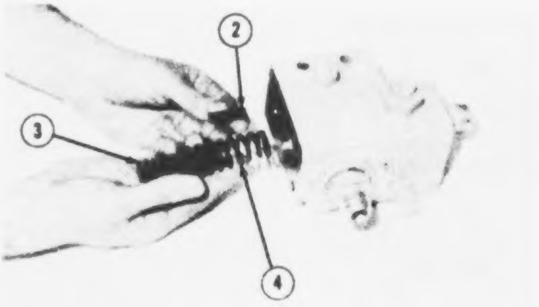
A15945X1

2. Put SAE 10 oil on valves (5) and (6). Install the valves in their respective bores. Install shims in the larger valve.



A15946X1

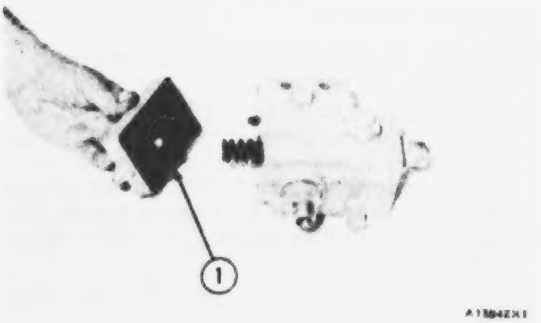
3. Install the spring (2) in the bore for the small valve and springs (3) and (4) in the bore for the large valve.



A15943X1

4. Be sure that the seals are installed in cover (1) and install the cover with four bolts.

NOTE: It may be necessary to use longer bolts to get compression of the springs for assembly.



A15942X1

HYDRAULIC FILTER

DISASSEMBLE HYDRAULIC FILTER 15–5068

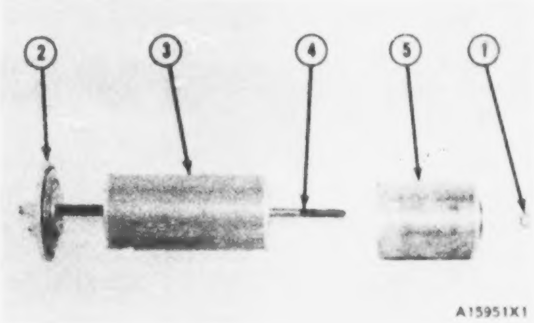
	TOOLS NEEDED	A
5F6501	Ring Compressor	1
1P2393	Puller Plate	1
1P1863	Pliers	1

1. Remove the filter from the tank.

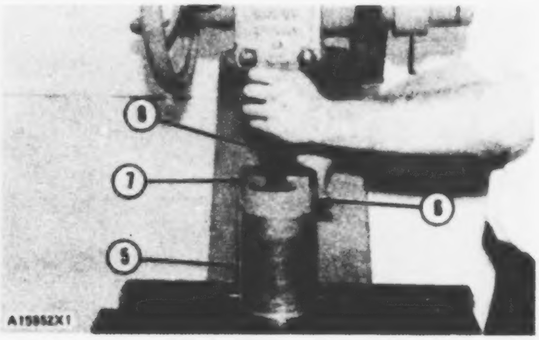
2. Remove nut (1) from the bolt.

3. Remove screen assembly (5), element (3), cover (2) and bolt (4).

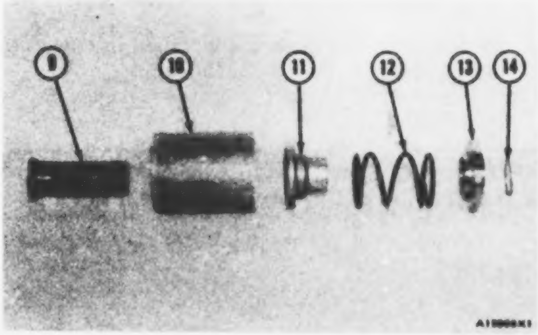
NOTE: This is the same procedure used to change element (2).



4. Put screen assembly (5) in a press.



5. Use tool group (A). Put ring compressor (6) in a position to set on spacer (13). Put puller plate (7) on top of ring compressor (6). Use the press for compression of spring (12) until spacer (13) is below snap ring (14). Use pliers (8) to remove snap ring (14). Slowly release the force on spacer (13). Remove spacer (13), valve (11) and tube assembly (9) from screen (10).



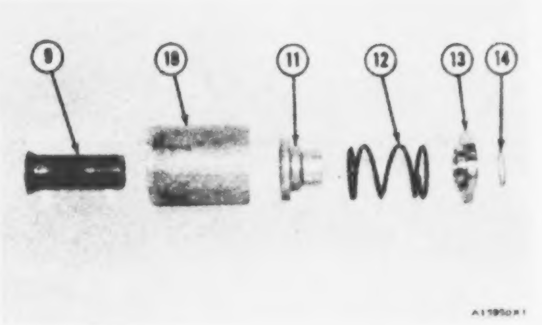
HYDRAULIC FILTER

ASSEMBLE HYDRAULIC FILTER

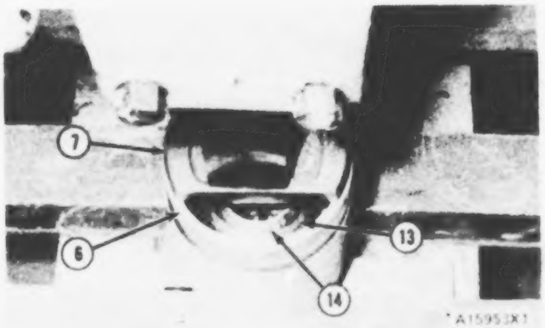
16–5068

	TOOLS NEEDED	A
5F6501	Ring Compressor	1
1P2393	Puller Plate	1
1P1863	Pliers	1

1. Install sleeve assembly (9) into screen (10). Install valve (11), spring (12) and spacer (13) in the opposite end of screen (10).



2. Put the screen assembly in a press. Use tool group (A). Set ring compressor (6) and puller plate (7) in place. Use the press to cause the compression of spring (12). Install snap ring (14) with pliers (8). Be sure that snap ring (14) is correctly installed. Slowly release the pressure on spacer (13).



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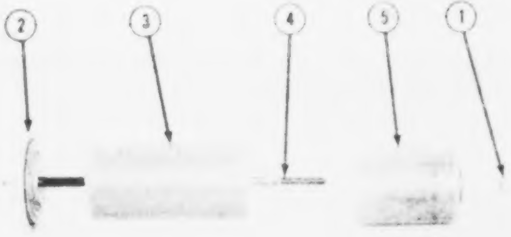
3. Install element (3) and screen assembly (5) on bolt (4). Put nut (1) on bolt (4) and tighten.

4. Install the filter in the tank.



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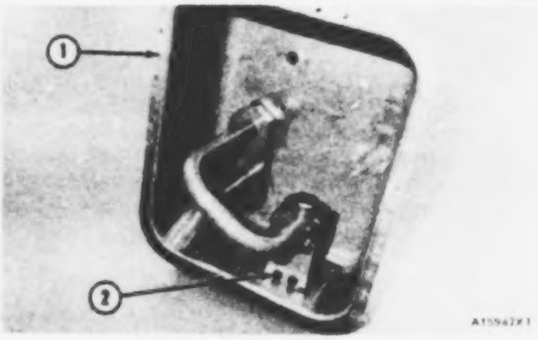
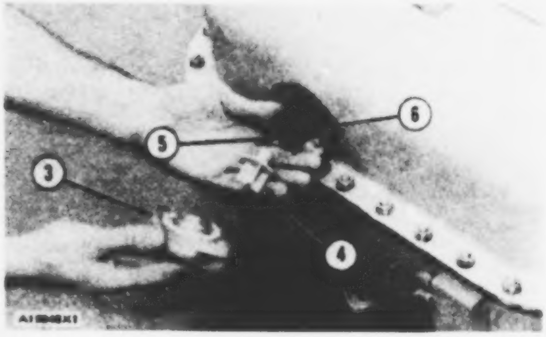
HYDRAULIC TANK

DISASSEMBLE HYDRAULIC TANK 15–5056

1. Remove the filter from the tank.



2. Remove 44 bolts (1) and carefully separate the tank in the middle. Remove two bolts (2) and take out the manifold and tubing.

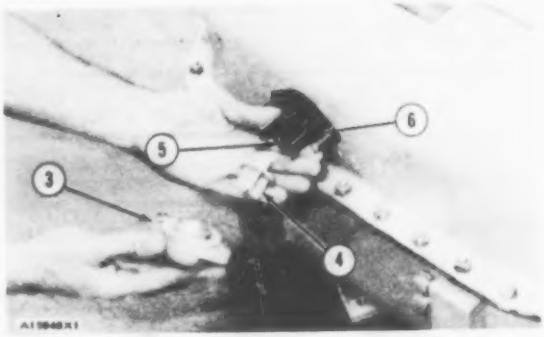


3. Remove two nuts and take off body (3). When body (3) is separated from the tank, valve (4), spring (5) and guide (6) can be removed.

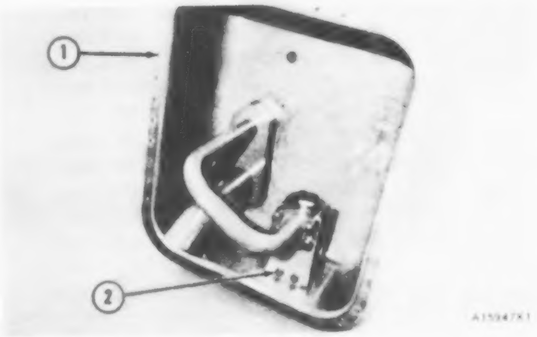
HYDRAULIC TANK

ASSEMBLE HYDRAULIC TANK 16–5056

1. Install the manifold in the tank.



2. Install guide (6), spring (5), valve (4) and body (3). Tighten the bolts holding the body.

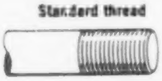


3. Carefully put the two halves of the tank in alignment. Install and tighten the 44 bolts (1).

4. Install the filter. Tighten the bolt on the filter to 43 ± 2 lb. ft. (5.9 ± 0.3 mkg).

GENERAL TIGHTENING TORQUE FOR BOLTS, NUTS AND TAPERLOCK STUDS

The following charts give the standard torque values for bolts, nuts and taperlock studs of SAE Grade 5 or better quality. Exceptions are given in the Specifications.

THREAD DIAMETER		STANDARD TORQUE	
inches	millimeters	lb. ft.	mkg
		Use these torques for bolts and nuts with standard threads.	
1/4	6.35	9 ± 3	1.24 ± 0.4
5/16	7.94	18 ± 5	2.5 ± 0.7
3/8	9.53	32 ± 5	4.4 ± 0.7
7/16	11.11	50 ± 10	6.9 ± 1.4
1/2	12.70	75 ± 10	10.4 ± 1.4
9/16	14.29	110 ± 15	15.2 ± 2.0
5/8	15.88	150 ± 20	20.7 ± 2.8
3/4	19.05	265 ± 35	36.6 ± 4.8
7/8	22.23	420 ± 60	58.1 ± 8.3
1	25.40	640 ± 80	88.5 ± 11.1
1 1/8	28.58	800 ± 100	110.6 ± 13.8
1 1/4	31.75	1000 ± 120	138 ± 16.6
1 3/8	34.93	1200 ± 150	166 ± 20.7
1 1/2	38.10	1500 ± 200	207 ± 27.7
		Use these torques for bolts and nuts on hydraulic valve bodies.	
5/16	7.94	13 ± 2	1.8 ± 0.3
3/8	9.53	24 ± 2	3.3 ± 0.3
7/16	11.11	39 ± 2	5.4 ± 0.3
1/2	12.70	60 ± 3	8.3 ± 0.4
5/8	15.88	118 ± 4	16.3 ± 0.5
Taperlock stud		Use these torques for studs with Taperlock threads.	
1/4	6.35	5 ± 2	0.69 ± 0.3
5/16	7.94	10 ± 3	1.4 ± 0.4
3/8	9.53	20 ± 3	2.8 ± 0.4
7/16	11.11	30 ± 5	4.1 ± 0.7
1/2	12.70	40 ± 5	5.5 ± 0.7
9/16	14.29	60 ± 10	8.3 ± 1.4
5/8	15.88	75 ± 10	10.4 ± 1.4
3/4	19.05	110 ± 15	15.2 ± 2.0
7/8	22.23	170 ± 20	23.5 ± 2.8
1	25.40	260 ± 30	35.9 ± 4.1
1 1/8	28.58	320 ± 30	44.2 ± 4.1
1 1/4	31.75	400 ± 40	55 ± 5.5
1 3/8	34.93	480 ± 40	66 ± 5.5
1 1/2	38.10	550 ± 50	76 ± 7

T95416-5

LINES, PLUGS AND FITTINGS

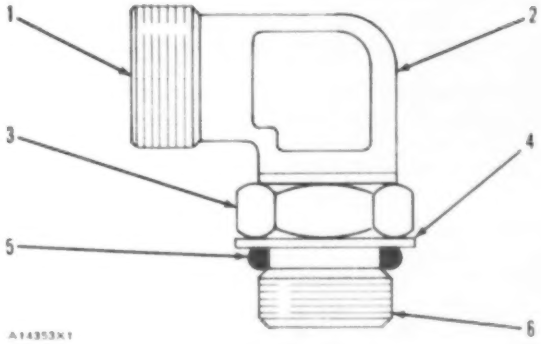
HYDRAULIC LINE INSTALLATION

1. For a metal tube to hose installation, install the tube and tighten all bolts finger tight.
2. Tighten the bolts at the rigid end.
3. Install the hose and tighten all bolts finger tight.
4. Put the hose in a position so that it does not contact the machine or another hose.
5. Tighten the bolts on both connections.
6. Start the diesel engine.
7. Move the implement control levers to all positions.
8. Watch the hose while the implement is in motion for making contact with the machine or other hoses.
9. Shut off the diesel engine.
10. If necessary, put the hose in a new position where it will not make contact when the implement is in motion.

ASSEMBLY OF FITTINGS WITH STRAIGHT THREADS AND O-RING SEALS

This type of fitting is used in many applications. The tube end of the fitting will be different in design so that it can be used in many different applications. However, the installation procedure of the fitting is the same wherever it is used. If the tube end of the fitting body is the same as in the illustration (either an elbow or a straight body) it will be necessary to assemble the sleeve on the tube before connecting the tube to the end.

1. Put the locknut (3), washer (4) and seal (5) as far back on the fitting body (2) as possible. Hold these components in this position. Turn the fitting into the part it is used on, until washer (4) just makes contact with the face of the part it is used on.



ELBOW BODY ASSEMBLY

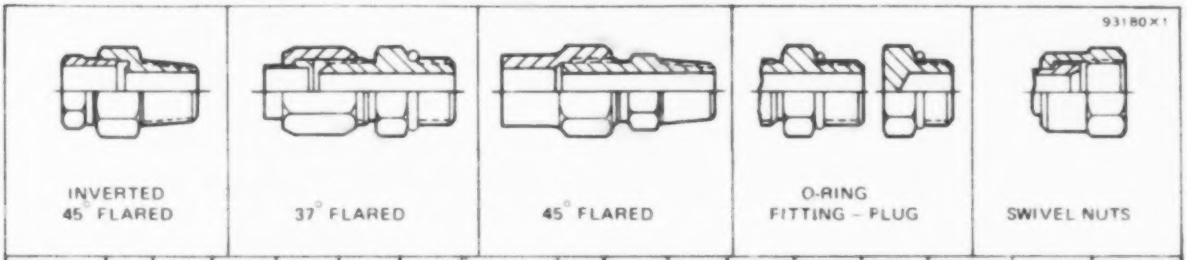
1. End of fitting body (connects to tube). 2. Fitting body. 3. Locknut. 4. Backup washer. 5. O-ring seal. 6. End of fitting that goes into other part.

2. Put the fitting assembly in its correct position by turning the body (2) out (counterclockwise) a maximum of 359°. Tighten locknut (3) finger tight.

NOTE: If the fitting is a connector (straight fitting) the hex on the body takes the place of the locknut. Install this type fitting by tightening the hex against the face of the part it is being put into.

TORQUES FOR FLARED AND O-RING FITTINGS

The torques shown in the following chart are to be used on the nut part of 37° Flared, 45° Flared and Inverted Flared fittings (when used with steel tubing), O-ring plugs, O-ring fittings and swivel nuts when used in applications to 3000 psi (210.9 kg/cm^2).



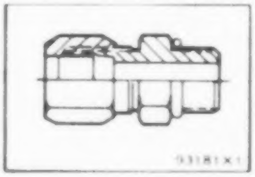
TUBE SIZE (O.D)						
	mm	3.18	4.78	6.35	7.92	9.52
	in.	.125	.188	.250	.312	.375
THREAD SIZE (in.)		5/16	3/8	7/16	1/2	9/16 5/8
TORQUE cm.kg		51.0 ±12.0	92.0 ±12.0	168.0 ±24.0	179.0 ±24.0	219.0 ±24.0
TORQUE lb.in		45 ±10	80 ±10	145 ±20	155 ±20	190 ±20

TUBE SIZE (O.D.)									
	mm	12.70	15.88	19.05	22.22	25.40	31.75	38.10	50.80
	in.	.500	.625	.750	.875	1.000	1.250	1.500	2.000
THREAD SIZE (in.)		3/4	7/8	1 1/16	1 3/16 1 1/4	1 5/16	1 5/8	1 7/8	2 1/2
TORQUE mkg.		4.5 ±0.7	5.5 ±0.7	7.6 ±0.7	9.0 ±0.7	11.1 ±0.7	13.8 ±1.4	16.6 ±1.4	31.8 ±2.8
TORQUE lb.ft.		30 ±5	40 ±5	55 ±5	65 ±5	80 ±5	100 ±10	120 ±10	230 ±20

TORQUES FOR OTHER FITTINGS

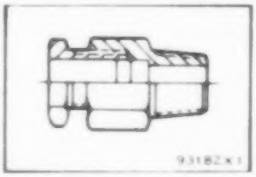
Ermeto Tube Fittings

Put nut and sleeve over the tube with head or shoulder end of sleeve next to nut. Push tube into counterbore of fitting body as far as possible. Turn nut clockwise until sleeve holds tube and prevents movement. Tighten the nut 1 1/4 turns more to seat sleeve and give a locking action. When necessary to assemble again, put sleeve over tube and tighten nut until a sudden increase in torque if felt. Then tighten 1/6 to 1/3 turn more to seat the sleeve.



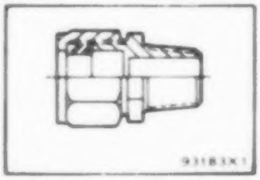
Flex Fittings

Put nut and sleeve over tubing and push tube into counterbore of fitting body as far as possible. Tighten the nut until it is against the hex part of the fitting body.



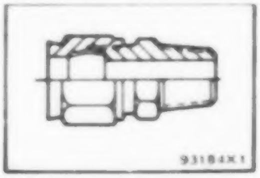
Hi Duty (shear sleeve) Tube Fittings

After tube has been put through the nut and makes contact against the tube shoulder in the fitting body, turn the nut with a wrench until a small decrease in torque is felt. This is an indication that the sleeve has been broken off of the nut. Hold the tube to prevent turning and tighten the nut 1 and 1/2 turns.



Hi Seal Fittings

Put nut and sleeve over the tubing with the short heavy end of the sleeve facing the end of tubing. Put the tube end against the counterbore in the body of the fitting and tighten until nut covers the last thread on the body. The remainder of space is used whenever the fitting is removed and installed again.



7J4634, 9J5058 HYDRAULIC PUMP
(173 HYDRAULIC CONTROL)

Rotation is counterclockwise when seen from drive end.

Type of pump: Vane.

For test use SAE 10W oil at 150° (65°C).

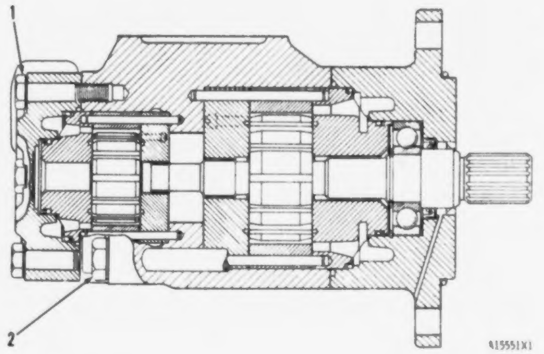
LARGE SECTION OF THE PUMP (Shaft End)

Test at Full Speed:

Output .... 34.5 U.S. gpm (130.6 lit/min)
at a pressure of .... 100 psi (7.0 kg/cm^2)
with pump at .... 2080 rpm
with engine at .... 2000 rpm
Output .... 32.9 U.S. gpm (124.5 lit/min)
at a pressure of .... 1000 psi (70.3 kg/cm^2)
with pump at .... 2080 rpm
with engine at .... 2000 rpm

Test at Half Speed:

Output .... 17.2 U.S. gpm (65.0 lit/min)
at a pressure of .... 100 psi (7.0 kg/cm^2)
with pump at .... 1040 rpm
with engine at .... 1000 rpm
Output .... 15.8 U.S. gpm (59.1 lit/min)
at a pressure of .... 1000 psi (70.3 kg/cm^2)
with pump at .... 1040 rpm
with engine at .... 1000 rpm



SMALL SECTION OF THE PUMP (Cover End)

Test at Full Speed:

Output .... 23.8 U.S. gpm (90.1 lit/min)
at a pressure of .... 100 psi (7.0 kg/cm^2)
with pump at .... 2080 rpm
with engine at .... 2000 rpm
Output .... 23.0 U.S. gpm (87.0 lit/min)
at a pressure of .... 1000 psi (70.3 kg/cm^2)
with pump at .... 2080 rpm
with engine at .... 2000 rpm

Test at Half Speed:

Output .... 11.6 U.S. gpm (44.0 lit/min)
at a pressure of .... 100 psi (7.0 kg/cm^2)
with pump at .... 1040 rpm
with engine at .... 1000 rpm
Output .... 10.8 U.S. gpm (41.0 lit/min)
at a pressure of .... 1000 psi (70.3 kg/cm^2)
with pump at .... 1040 rpm
with engine at .... 1000 rpm

(1) Torque for bolts (four) .... 45 ± 5 lb.ft. (6.2 ± 0.7 mkg)
(2) Torque for bolts .... 70 ± 5 lb.ft. (10.4 ± 0.7 mkg)

NOTE: FOR TORQUE VALUES NOT GIVEN, SEE THE FIRST PAGE OF SPECIFICATIONS FOR GENERAL TIGHTENING TORQUES

7J612 , 9J5050 HYDRAULIC PUMP
(183 HYDRAULIC CONTROL)

(1) Torque for cover bolts .... 45 ± 5 lb.ft. (6.2 ± 0.7 mkg)

(2) Torque for body bolts .... 150 ± 10 lb.ft. (20.9 ± 1.4 mkg)

Rotation is counterclockwise when seen from drive end.

Type of pump: Vane.

For test use SAE 10W oil at 150°F (65°C).

LARGE SECTION (Shaft End)

Test at Full Speed:

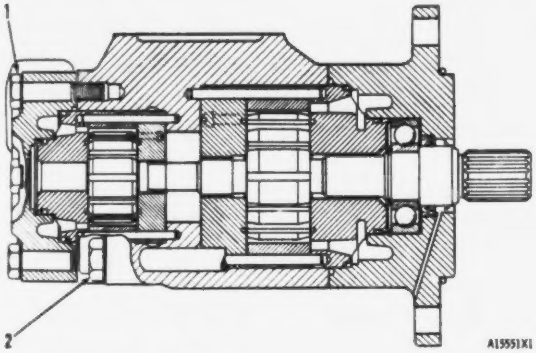
Output .... 57.7 U.S. gpm (218.4 lit/min)
at a pressure of .... 100 psi (7.0 kg/cm^2)
with pump at .... 2720 rpm
with engine at .... 1850 rpm

Output .... 54.5 U.S. gpm (206.3 lit/min)
at a pressure of .... 1000 psi (70.3 kg/cm^2)
with pump at .... 2720 rpm
with engine at .... 1850 rpm

Test at Half Speed:

Output .... 28.4 U.S. gpm (107.5 lit/min)
at a pressure of .... 100 psi (7.0 kg/cm^2)
with pump at .... 1360 rpm
with engine at .... 925 rpm

Output .... 25.4 U.S. gpm (96.0 lit/min)
at a pressure of .... 1000 psi (70.3 kg/cm^2)
with pump at .... 1360 rpm
with engine at .... 925 rpm



SMALL SECTION (Cover End)

Test at Full Speed:

Output .... 22.0 U.S. gpm (83.2 lit/min)
at a pressure of .... 100 psi (7.0 kg/cm^2)
with pump at .... 2720 rpm
with engine at .... 1850 rpm

Output .... 21.2 U.S. gpm (80.2 lit/min)
at a pressure of .... 1000 psi (70.3 kg/cm^2)
with pump at .... 2720 rpm
with engine at .... 1850 rpm

Test at Half Speed:

Output .... 10.7 U.S. gpm (40.5 lit/min)
at a pressure of .... 100 psi (7.0 kg/cm^2)
with pump at .... 1360 rpm
with engine at .... 925 rpm

Output .... 9.8 U.S. gpm (37.1 lit/min)
at a pressure of .... 1000 psi (70.3 kg/cm^2)
with pump at .... 1360 rpm
with engine at .... 925 rpm

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8J5409 HYDRAULIC PUMP
(193 HYDRAULIC CONTROL)

Torque for nut on clamp of seal assemblies (two), on oil lines from tank to pump .... 73 ± 3 lb.ft. (10.1 ± 0.4 mkg)

Torque for body bolts (eight) ...... 120 ± 10 lb.ft. (16.6 ± 1.4 mkg)

Rotation is counterclockwise when seen from drive end.

Type of pump: gear.

For test use SAE 10W oil at 150°F (65°C).

LARGE SECTION (Shaft End)

Test at Full Speed:

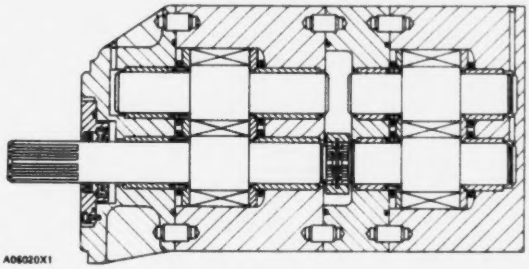
Output .... 71.0 U.S. gpm (269.0 lit/min)
at a pressure of .... 100 psi (7.0 kg/cm²)
with pump at .... 2380 rpm
with engine at .... 1800 rpm

Output .... 68.0 U.S. gpm (257.4 lit/min)
at a pressure of .... 1000 psi (70.3 kg/cm²)
with pump at .... 2380 rpm
with engine at .... 1800 rpm

Test at Half Speed:

Output .... 36.0 U.S. gpm (136.3 lit/min)
at a pressure of .... 100 psi (7.0 kg/cm²)
with pump at .... 1190 rpm
with engine at .... 900 rpm

Output .... 33.0 U.S. gpm (125.0 lit/min)
at a pressure of .... 1000 psi (70.3 kg/cm²)
with pump at .... 1190 rpm
with engine at .... 900 rpm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SMALL SECTION (Cover End)

Test at Full Speed:

Output .... 23.0 U.S. gpm (87.0 lit/min)
at a pressure of .... 100 psi (7.0 kg/cm²)
with pump at .... 2380 rpm
with engine at .... 1800 rpm

Output .... 21.0 U.S. gpm (79.5 lit/min)
at a pressure of .... 1000 psi (70.3 kg/cm²)
with pump at .... 2380 rpm
with engine at .... 1800 rpm

Test at Half Speed:

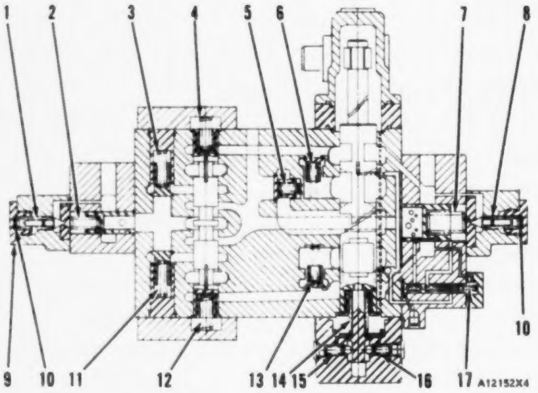
Output .... 13.0 U.S. gpm (49.2 lit/min)
at a pressure of .... 100 psi (7.0 kg/cm²)
with pump at .... 1190 rpm
with engine at .... 900 rpm

Output .... 11.0 U.S. gpm (42.0 lit/min)
at a pressure of .... 1000 psi (70.3 kg/cm²)
with pump at .... 1190 rpm
with engine at .... 900 rpm

NOTE: FOR TORQUE VALUES NOT GIVEN, SEE THE FIRST PAGE OF SPECIFICATIONS FOR GENERAL TIGHTENING TORQUES

LIFT AND TILT CONTROL VALVE

9J7144 (173)
8J7435 (183)
9J7143 (193)



(1) 2J6089 Spring for tilt relief valve:

Length under test force .... 1.43 in. (36.3 mm)

Test force .... 67.6 ± 3.4 lb. (30.7 ± 1.5 kg)

Free length after test .... 1.74 in. (44.2 mm)

Outside diameter .... .49 in. (12.4 mm)

(2) 8F394 Spring for dump valve:

Length under test force .... 1.219 in. (30.96 mm)

Test force .... 5.4 to 6 lb. (2.5 to 2.7 kg)

Free length after test .... 2.250 in. (56.55 mm)

Outside diameter .... .484 in. (12.30 mm)

(3) 2N7029 Spring for the load check valve:

Length under test force .... 1.22 in. (31.0 mm)

Test force .... 4.00 lb. (1.8 kg)

Free length after test .... 1.97 in. (50.0 mm)

Outside diameter .... .375 in. (9.53 mm)

(4) 9J5753 Spring for the valve spool (inner):

Length under test force .... 1.516 in. (38.50 mm)

Test force .... 7.0 ± 1.6 lb. (3.2 ± 0.73 kg)

Free length after test .... 1.86 in. (47.2 mm)

Outside diameter .... .390 in. (9.9 mm)

9J5754 Spring for the valve spool (outer):

Length under test force .... 1.516 in. (38.5 mm)

Test force .... 15.0 ± 1.2 lb. (6.8 ± 0.54 kg)

Free length after test .... 1.99 in. (50.5 mm)

Outside diameter .... .594 in. (15.08 mm)

(5) 1L4418 Spring for the load check valve:

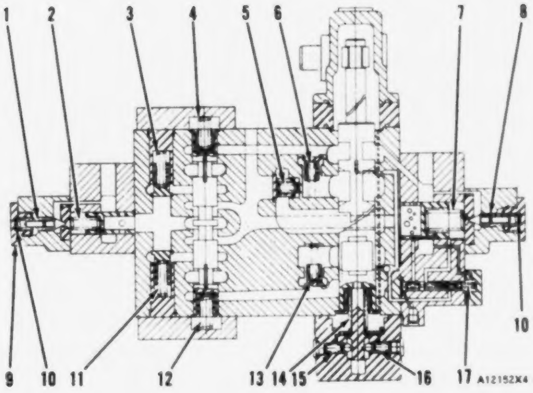
Length under test force .... 1.469 in. (37.31 mm)

Test force .... 4.9 to 5.5 lb. (2.2 to 2.5 kg)

Free length after test .... 3.781 in. (96.04 mm)

Outside diameter .... .8125 in. (20.638 mm)

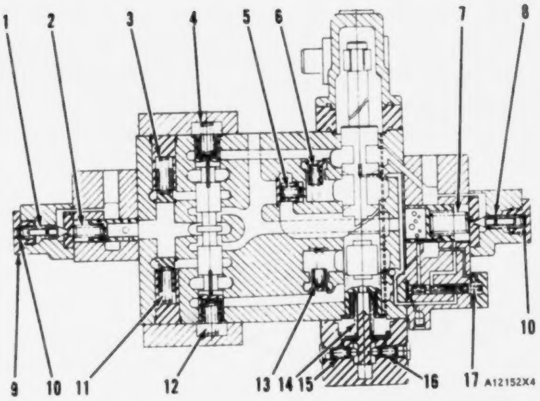
Lift and Tilt Control Valve (Cont.)



(6)	3B1926 Spring for the make-up valve:	
	Length under test force	1.8125 in. (46.04 mm)
	Test force	4.31 to 4.85 lb. (2.0 to 2.2 kg)
	Free length after test	2.875 in. (73.03 mm)
	Outside diameter	.406 in. (10.32 mm)
(7)	9J5498 Spring for dump valve (inner):	
	Length under test force	1.812 in. (46.02 mm)
	Test force	45 ± 2.25 lb. (20.4 ± 1.0 kg)
	Free length after test	2.71 in. (68.8 mm)
	Outside diameter	.825 in. (21.0 mm)
	9J5499 Spring for dump valve (outer):	
	Length under test force	1.812 in. (46.02 mm)
	Test force	20 ± 1.0 lb. (9.1 ± 0.45 kg)
	Free length after test	2.68 in. (68.1 mm)
	Outside diameter	.578 in. (14.68 mm)
(8)	2J6089 Spring for main relief valve:	
	Length under test force	1.43 in. (36.3 mm)
	Test force	67.6 ± 3.4 lb. (30.7 ± 1.5 kg)
	Free length after test	1.74 in. (44.2 mm)
	Outside diameter	.49 in. (12.4 mm)
(9)	Torque for plug when installing relief valve	80 ± 3 lb.ft. (11.1 ± 0.41 mkg)
(10)	Thickness of 3J7470 Shim	.048 in. (1.2 mm)
	Thickness of 3J7473 Shim	.005 in. (0.13 mm)
	One 3J7473 Shim will change pressure	35 psi (2.5 kg/cm^2)
(11)	2N7029 Spring for the make-up valve:	
	Length under test force	1.22 in. (30.9 mm)
	Test force	4.00 lb. (1.8 kg)
	Free length after test	1.97 in. (50.0 mm)
	Outside diameter	.375 in. (9.53 mm)

NOTE: FOR TORQUE VALUES NOT GIVEN, SEE THE FIRST PAGE OF SPECIFICATIONS FOR GENERAL TIGHTENING TORQUES

Lift and Tilt Control Valve (Cont.)



(12) 9J5753 Spring for the valve spool (inner):

Length under test force	1.516 in. (38.51 mm)
Test force	7.0 ± 1.6 lb. (3.2 ± 0.73 kg)
Free length after test	1.86 in. (47.2 mm)
Outside diameter	.390 in. (9.90 mm)

9J5754 Spring for the valve spool (outer):

Length under test force	1.516 in. (38.50 mm)
Test force	15.0 ± 1.2 lb. (6.8 ± 0.54 kg)
Free length after test	1.99 in. (50.5 mm)
Outside diameter	.594 in. (15.0 mm)

(13) 3B1926 Spring for the make-up valve:

Length under test force	1.8125 in. (46.04 mm)
Test force	4.31 to 4.85 lb. (2.0 to 2.2 kg)
Free length after test	2.875 in. (73.03 mm)
Outside diameter	.406 in. (10.32 mm)

(14) 4J4790 Spring for the valve spool:

Length under test force	1.55 in. (39.4 mm)
Test force	12.27 lb. (5.6 kg)
Free length after test	2.16 in. (54.9 mm)
Outside diameter	.72 in. (18.3 mm)

(15), (16) 5J1389 Spring for the detents:

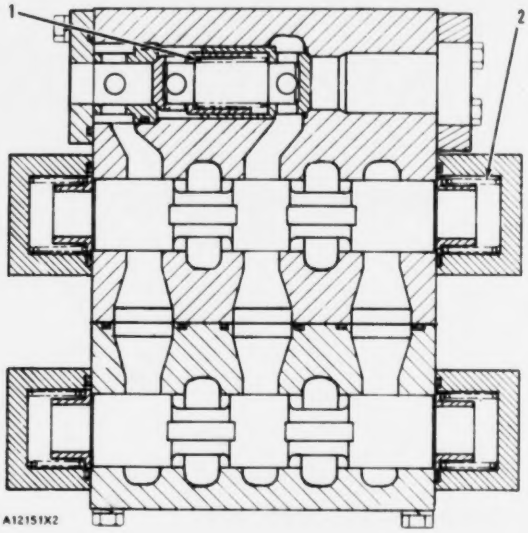
Length under test force	.640 in. (16.26 mm)
Test force	9.00 ± .72 lb. (4.1 ± 0.33 kg)
Free length after test	.82 in. (20.8 mm)
Outside diameter	.44 in. (11.2 mm)

(17) 9J5756 Spring for the shuttle valve:

Length under test force	1.31 in. (33.3 mm)
Test force	7.0 ± 0.6 lb. (3.18 ± 0.3 kg)
Free length after test	1.59 in. (40.4 mm)
Outside diameter	.438 in. (11.13 mm)

RIPPER LIFT AND TIP VALVES

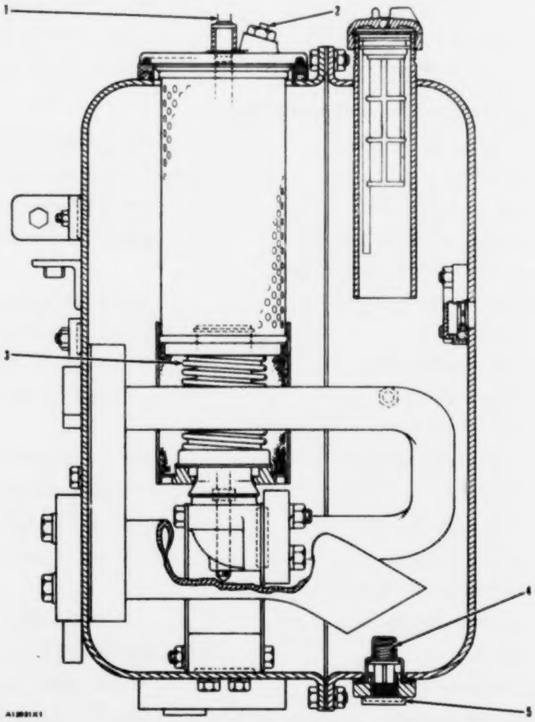
9J2918 (173 LIFT ONLY)
9J2918 (183 LIFT ONLY)
9J2919 (183 LIFT AND TIP)
8J8550 (193 LIFT ONLY)
8J8579 (193 LIFT AND TIP)



(1)	4H1718 Spring for the check valve:	
	Length under test force	1.47 in. (37.3 mm)
	Test force	3.14 ± .16 lb. (3.6 ± 0.07 kg)
	Free length after test	3.00 in. (76.2 mm)
	Outside diameter	1.00 in. (25.4 mm)
(2)	7F9414 Spring on the valve spool (four locations):	
	Length under test force	1.88 in. (47.6 mm)
	Test force	34.8 ± 2.8 lb. (15.8 ± 1.3 kg)
	Free length after test	2.44 in. (62.0 mm)
	Outside diameter	1.50 in. (38.1 mm)

HYDRAULIC TANK AND FILTER

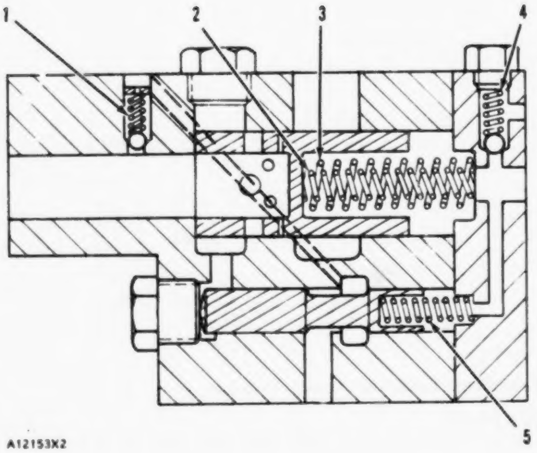
8J8778 (173 & 183)
8J8779 (193)



(1)	Torque for bolt	43 ± 2 lb.ft. (5.9 ± 0.3 mkg)
(2)	6J468 Indicator (for filter element):	
	Torque for indicator	25 ± 2 lb.ft. (3.5 ± 0.3 mkg)
	Difference between pressure of filtered and unfiltered oil when 1/2 of indicator is seen	12 to 15 psi (0.8 to 1.0 kg/cm²)
(3)	8J8443 Spring for the relief valve:	
	Length under test force	3.375 in. (85.73 mm)
	Test force	162 ± 16 lb. (73.5 ± 7.3 kg)
	Free length after test	5.00 in. (127.0 mm)
	Outside diameter	3.64 in. (92.5 mm)
(4)	7B3039 Spring for the dump valve:	
	Length under test force	1.03 in. (26.2 mm)
	Test force	3.50 ± .28 lb. (1.6 ± 0.13 kg)
	Free length after test	1.44 in. (36.6 mm)
	Outside diameter	.66 in. (16.8 mm)
(5)	Torque for plug	50 ± 5 lb.ft. (6.9 ± 0.7 mkg)

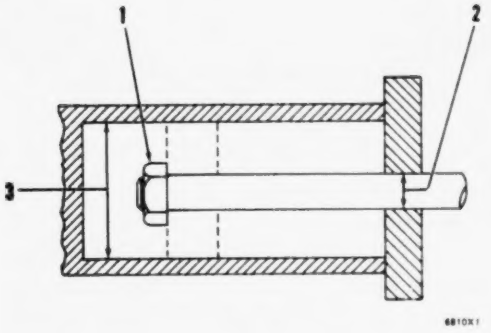
NOTE: FOR TORQUE VALUES NOT GIVEN, SEE THE FIRST PAGE OF SPECIFICATIONS FOR GENERAL TIGHTENING TORQUES

RESTRICTOR VALVE
(9J3581)



(1) 4M2381 Spring for the check valve:	
Length under test force	.48 in. (12.2 mm)
Test force	.517 ± .041 lb. (0.23 ± 0.02 kg)
Free length after test	.89 in. (22.6 mm)
Outside diameter	.300 in. (7.62 mm)
(2) 9J5490 Spring for the dump valve (inner):	
Length under test force	1.93 in. (49.0 mm)
Test force	35.2 ± 1.76 lb. (16.0 ± 0.8 kg)
Free length after test	2.82 in. (71.6 mm)
Outside diameter	.686 in. (17.42 mm)
(3) 9J5491 Spring for the dump valve (outer):	
Length under test force	1.93 in. (49.0 mm)
Test force	80.50 ± 4.02 lb. (36.5 ± 1.8 kg)
Free length after test	2.94 in. (74.7 mm)
Outside diameter	.982 in. (24.94 mm)
(4) 5J1355 Spring:	
Length under test force	.78 in. (19.8 mm)
Test force	3.0 ± .2 lb. (1.4 ± 0.1 kg)
Free length after test	1.010 ± .016 in. (25.65 ± 0.41 mm)
Outside diameter	.203 ± .005 in. (5.16 ± 0.13 mm)
(5) 9J7753 Spring for the shuttle valve spool:	
Length under test force	.940 in. (23.88 mm)
Test force	7.00 ± .56 lb. (3.2 ± 0.3 kg)
Free length after test	1.250 in. (31.75 mm)
Outside diameter	.344 in. (8.74 mm)
Thickness of 4J8224 Shim	.005 in. (0.13 mm)
One shim will change pressure	35 psi (2.5 kg/cm²)

HYDRAULIC CYLINDERS
(D7 TRACTORS)



6J9752 Cylinder for Blade Tilt (7S and 7U Dozer)

(1) Torque for nut on rod .... 1600 ± 200 lb.ft. (221.3 ± 27.7 mkg)

(2) Bore of new head .... 3.003 ± .001 in. (76.28 ± 0.03 mm)

Diameter of new rod .... 2.998 ± .001 in. (76.15 ± 0.03 mm)

(3) Bore of new cylinder .... 6.500 + .005 or - .002 in. (165.1 + 0.13 or - 0.05 mm)

7J3333 (RH), 7J3334 (LH) Cylinder for Blade Lift

(1) Torque for nut on rod .... 1200 ± 120 lb.ft. (166.0 ± 16.6 mkg)

(2) Bore of a new head .... 2.503 ± .001 in. (63.58 ± 0.03 mm)

Diameter of a new rod .... 2.4980 ± .0015 in. (63.449 ± 0.038 mm)

(3) Bore of a new cylinder .... 4.750 + .005 or - .002 in. (120.7 + 0.13 or - 0.05 mm)

3J6439 Cylinder for Ripper Lift

(1) Torque for nut on rod .... 1600 ± 120 lb.ft. (221.3 ± 16.6 mkg)

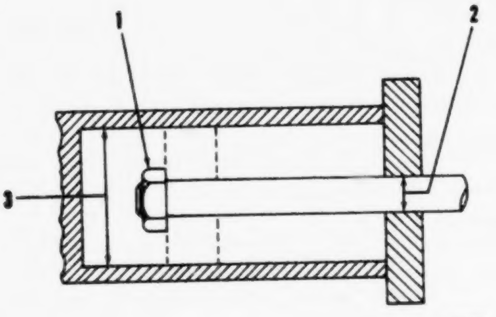
(2) Bore of a new head .... 2.503 ± .001 in. (63.58 ± 0.03 mm)

Diameter of a new rod .... 2.498 ± .001 in. (63.45 ± 0.03 mm)

(3) Bore of a new cylinder .... 6.000 + .005 or - .002 in. (152.40 + 0.13 or - 0.05 mm)

NOTE: FOR TORQUE VALUES NOT GIVEN, SEE THE FIRST PAGE OF SPECIFICATIONS FOR GENERAL TIGHTENING TORQUES

HYDRAULIC CYLINDERS
(D8 TRACTORS)



8J8682 Cylinder for Blade Tilt

(1) Torque for nut on rod . . . . 1200 ± 120 lb.ft. (166.0 ± 16.6 mkg)

(2) Bore of new head . . . . 3.503 ± .001 in. (88.98 ± 0.03 mm)

Diameter of new rod . . . . 3.4980 ± .0015 in. (88.849 ± 0.038 mm)

(3) Bore of new cylinder . . . . 8.250 + .005 or - .002 in. (209.55 + 0.13 or - 0.05 mm)

8J9395 (RH), 8J9396 (LH) Cylinder for Blade Lift (8A Dozer)

(1) Torque for nut on rod . . . . 1600 ± 160 lb.ft. (221.3 ± 22.1 mkg)

(2) Bore of a new head . . . . 2.753 ± .001 in. (69.92 ± 0.03 mm)

Diameter of a new rod . . . . 2.7480 ± .0015 in. (69.799 ± 0.038 mm)

(3) Bore of a new cylinder . . . . 5.000 + .005 or - .002 in. (127.0 + 0.13 or - 0.05 mm)

7J3221 (RH), 7J3222 (LH) Cylinder for Ripper Lift

(1) Torque for nut on rod . . . . 2300 ± 230 lb.ft. (318.1 ± 31.8 mkg)

(2) Bore of a new head . . . . 3.253 ± .001 in. (82.63 ± 0.03 mm)

Diameter of a new rod . . . . 3.2480 ± .0015 in. (82.499 ± 0.038 mm)

(3) Bore of a new cylinder . . . . 8.250 + .005 or - .002 in. (209.55 + 0.13 or - 0.05 mm)

8J8584 (RH), 8J8585 (LH) Cylinder for Blade Lift (8U and 8S Dozer)

(1) Torque for nut on rod . . . . 1600 ± 160 lb.ft. (221.3 ± 22.1 mkg)

(2) Bore of a new head . . . . 2.753 ± .001 in. (69.92 ± 0.03 mm)

Diameter of a new rod . . . . 2.7480 ± .0015 in. (69.799 ± 0.038 mm)

(3) Bore of a new cylinder . . . . 5.000 + .005 or - .002 in. (127.0 + 0.13 or - 0.05 mm)

6J9129 Cylinder for Ripper Tip

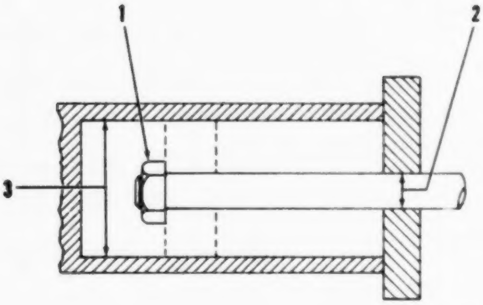
(1) Torque for nut on rod . . . . 2650 ± 265 lb.ft. (366.5 ± 36.7 mkg)

(2) Bore of a new head . . . . 3.003 ± .001 in. (76.28 ± 0.03 mm)

Diameter of a new rod . . . . 2.9980 ± .0015 in. (76.150 ± 0.038 mm)

(3) Bore of a new cylinder . . . . 7.250 + .005 or - .002 in. (184.15 + 0.13 or - 0.05 mm)

HYDRAULIC CYLINDERS
(D9 TRACTORS)



5J2897, 5J3037 Cylinders for Blade Lift

(1) Torque for nut with lubricant on threads of nut and rod . . . . 2000 ± 200 lb.ft. (276.6 ± 27.7 mkg)

(2) Bore of a new head . . . . 3.003 ± .001 in. (76.3 ± 0.03 mm)

Diameter of a new rod . . . . 2.9980 ± .0015 in. (76.15 ± 0.03 mm)

(3) Bore of a new cylinder . . . . 6.250 + .005 or - .002 in. (158.75 + 0.13 or - 0.05 mm)

5J3133 Cylinder For "C" Dozer Blade Lift

(1) Torque for nut on rod . . . . 800 ± 75 lb.ft. (110.6 ± 10.4 mkg)

(2) Bore of a new head . . . . 2.753 ± .001 in. (69.9 ± 0.03 mm)

Diameter of a new rod . . . . 2.7480 ± .0015 in. (69.74 ± 0.04 mm)

(3) Bore of a new cylinder . . . . 7.000 + .005 or - .002 in. (177.80 + 0.13 or - 0.05 mm)

6J1570 Cylinder For Blade Tilt

(1) Torque for nut on rod . . . . 1200 ± 100 lb.ft. (166.0 ± 13.8 mkg)

(2) Bore of a new head . . . . 3.503 ± .001 in. (89.0 ± 0.03 mm)

Diameter of a new rod . . . . 3.4980 ± .0015 in. (88.85 ± 0.03 mm)

(3) Bore of a new cylinder . . . . 8.250 + .005 or -.002 in. (209.55 + 0.13 or - 0.05 mm)

7J1487, 7J1488 Cylinder for Ripper Lift

(1) Torque for nut on rod . . . . 3000 ± 300 lb.ft. (414.9 ± 41.5 mkg)

(2) Bore of a new head . . . . 3.254 ± .002 in. (82.65 ± 0.05 mm)

Diameter of a new rod . . . . 3.2480 ± .0015 in. (82.50 ± 0.03 mm)

(3) Bore of a new cylinder . . . . 9.250 + .005 or - .002 in. (234.95 + 0.13 or - 0.05 mm)

6J7810 Cylinder For Ripper (variable pitch)

(1) Torque for nut on rod . . . . 3000 ± 300 lb.ft. (414.9 ± 41.5 mkg)

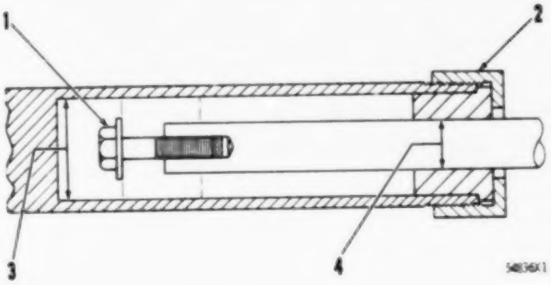
(2) Bore of a new head . . . . 3.503 ± .001 in. (89.0 ± 0.03 mm)

Diameter of a new rod . . . . 3.4980 ± .0015 in. (88.85 ± 0.03 mm)

(3) Bore of new cylinder . . . . 8.250 + .005 or - .002 in. (209.55 + 0.13 or - 0.05 mm)

NOTE: FOR TORQUE VALUES NOT GIVEN, SEE THE FIRST PAGE OF SPECIFICATIONS FOR GENERAL TIGHTENING TORQUES

HYDRAULIC CYLINDER
(183 & 193)



8J2071 Cylinder For Pulling Pin

(1)	Torque for bolt	640 ± 80 lb.ft. (88.5 ± 11.1 mkg)
(2)	Torque for crown	350 to 550 lb.ft. (48.4 to 76.1 mkg)
(3)	Bore in new cylinder	4.000 + .005 or - .002 in. (101.6 + 0.13 or - 0.05 mm)
(4)	Bore in new head	1.503 ± .001 in. (38.1 ± 0.03 mm)
	Diameter of new rod	1.500 ± .0015 in. (38.2 ± 0.04 mm)

QUICK DROP VALVES

5J3863 Valve (173 Hydraulic Control)

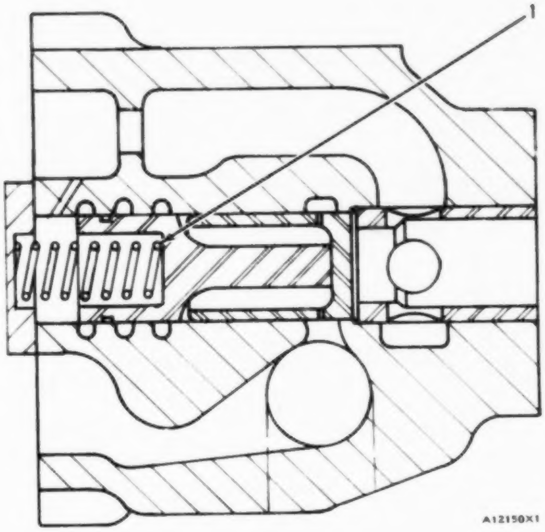
(1)	5J3719 Spring for plunger:	
	Length under test force	2.00 in. (50.8 mm)
	Test force	12.0 ± 1.0 lb. (5.4 ± 0.5 kg)
	Free length after test	3.20 in. (81.3 mm)
	Outside diameter	1.00 ± 0.02 in. (25.4 ± 0.5 mm)
	Torque for bolts to install valve	118 ± 12 lb.ft. (16.3 ± 1.7 mkg)

6J608 Valve (183 Hydraulic Control)

(1)	7M1297 Spring for plunger:	
	Length under test force	2.00 in. (50.8 mm)
	Test force	39.54 ± 3.16 lb. (17.94 ± 1.43 kg)
	Free length after test	2.98 in. (75.7 mm)
	Outside diameter	.880 in. (22.0 mm)
	Torque for valve mounting bolts	118 ± 12 lb.ft. (16.3 ± 1.7 mkg)

5J4845 Valve (193 Hydraulic Control)

(1)	7M1297 Spring for the plunger:	
	Length under test force	2.00 in. (50.8 mm)
	Test force	39.54 ± 3.16 lb. (17.94 ± 1.43 kg)
	Free length after test	2.98 in. (75.7 mm)
	Outside diameter	.88 in. (22.0 mm)
	Torque for bolts to install valve	118 ± 12 lb.ft. (16.3 ± 1.7 mkg)
	Torque for bolts to install oil tubes	65 ± 5 lb.ft. (9.0 ± 0.7 mkg)



PUSH ARM AND BRACE GROUP

7S (60K) and 7U (61K) Bulldozers

(1) Distance between the center of each trunnion bearing .... 116.24 in. (2952.5 mm)

(2) The distance the screw is out of each brace must be the same after the adjustment for distance (1) and distance (3) is correct.

(3) Distance between back of the bulldozer blade and each strut assembly .... 1.00 in. (25.4 mm)

Torque for bolts that fasten the brace and tilt cylinder to top of blade (four each side) .... 280 ± 20 lb.ft. (38.7 ± 2.8 mkg)

8S (29V) and 8U (30V) Bulldozers

(1) Distance between the center of each trunnion bearing .... 116.24 in. (2952.5 mm)

(2) The distance the screw is out of each brace must be the same after the adjustment for distance (1) and distance (3) is correct.

(3) Distance between back of the bulldozer blade and each strut assembly .... 1.50 in. (38.1 mm)

Torque for bolts that fasten the brace and tilt cylinder to top of blade (four each side) .... 280 ± 20 lb.ft. (38.7 ± 2.8 mkg)

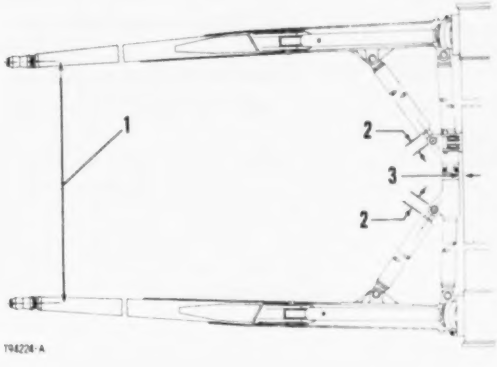
9S (18K) and 9U (19K) Bulldozers

(1) Distance between the center of each trunnion bearing .... 126.88 in. (3222.8 mm)

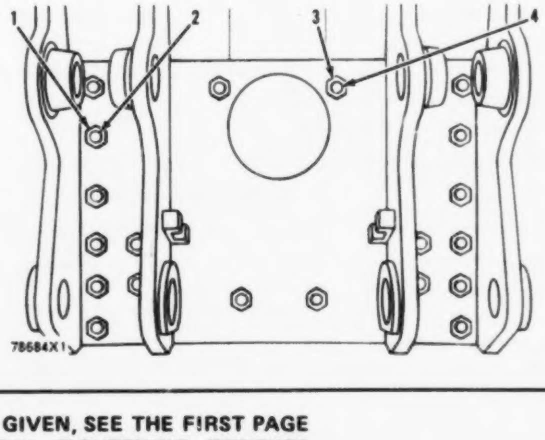
(2) The distance the screw is out of each brace must be the same after the adjustment for distance (1) and distance (3) is correct.

(3) Distance between back of the bulldozer blade and each strut assembly .... 1.50 in. (30.1 mm)

NOTE: Tilt bulldozers 9S, 18K and 9U, 19K have the hydraulic cylinder on either the (R.H.) or the (L.H.) push arm.



MOUNTING BRACKETS FOR RIPPER



(1) Torque for nuts (eighteen) with lubricant on threads .... 1800 ± 180 lb.ft. (248.9 ± 24.9 mkg)

(2) Torque for studs (eighteen) .... 550 ± 50 lb.ft. (76.1 ± 6.9 mkg)

(3) Torque for nuts (two) with lubricant on threads .... 1000 ± 100 lb.ft. (138.3 ± 13.8 mkg)

(4) Torque for studs (two) .... 400 ± 40 lb.ft. (55.3 ± 5.5 mkg)

NOTE: FOR TORQUE VALUES NOT GIVEN, SEE THE FIRST PAGE OF SPECIFICATIONS FOR GENERAL TIGHTENING TORQUES

CUTTING EDGES AND END BITS

7A, 7S and 7U Bulldozers

(1) Torque for nuts on bolts through cutting edges:

7A Bulldozer . . . . 350 ± 50 lb.ft. (48.4 ± 6.9 mkg)

7S and 7U Bulldozer . . . . 565 ± 85 lb.ft. (78.1 ± 11.8 mkg)

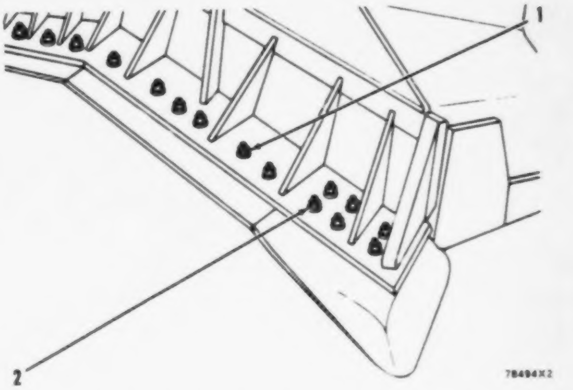
(2) Torque for nuts on bolts through end bits . . . . 565 ± 85 lb.ft. (78.1 ± 11.8 mkg)

8A, 8S and 8U Bulldozers

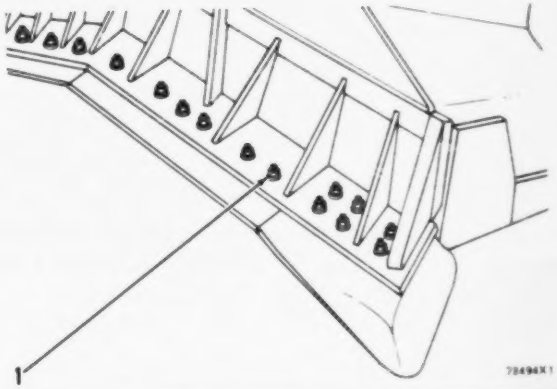
(1) Torque for nuts on bolts through cutting edges:

8A, 8S and 8U Bulldozer . . . . 900 ± 110 lb.ft. (124.5 ± 15.2 mkg)

(2) Torque for nuts on bolts through end bits . . . . 900 ± 110 lb.ft. (124.5 ± 15.2 mkg)



78494X2



78494X1

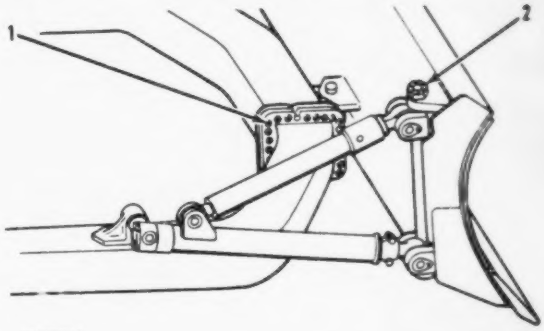
9S, 9U and 9A Bulldozers

(1) Torque for nuts on bolts through cutting edges and end bits . . . . 850 ± 150 lb.ft. (117.6 ± 20.7 mkg)

9C Bulldozer

(1) Torque for nuts on bolts through cutting edges and end bits . . . . 900 ± 110 lb.ft. (124.5 ± 15.2 mkg)

9C BULLDOZER FRAME



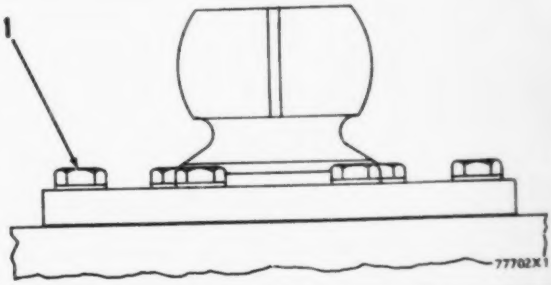
78577X1

(1) Torque for nuts (thirty one) . . . . 900 to 1000 lb.ft. (124.5 to 138.3 mkg)

(2) Torque for nut (two), minimum . . . . 200 lb.ft. (27.7 mkg)

NOTE: If needed, to install pin, tighten nut to next slot.

TRUNNION 9A, 9S and 9U BULLDOZERS
(6J5520)



77702X1

(1) Torque for bolts (ten) . . . . 850 ± 150 lb.ft. (117.6 ± 20.7 mkg)

FO-1. Schematic of Hydraulic Components.
(See back of Manual)

CHAPTER 5
LUBRICATION AND MAINTENANCE

SEBU5200

LUBRICATION & MAINTENANCE GUIDE

D8K TRACTOR

POWER SHIFT

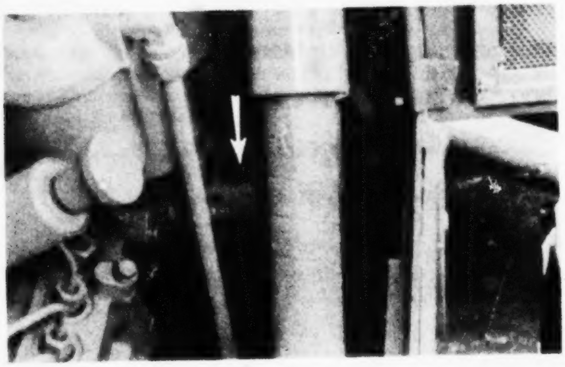
SERIAL NUMBERS | **77V1-UP**
66V1-UP

FOREWORD

This book is a guide to equipment care. The illustrated, step-by-step instructions are grouped by servicing intervals; items without specific intervals are listed under "When Required". Circled numbers in the Lubrication and Maintenance Chart are to key the charted items to the instructions in the book.

Use the service meter to determine servicing intervals. Calendar intervals (daily, weekly, 2 weeks, etc.) shown may be used instead of service meter intervals if it provides more convenient servicing schedules; and approximates the indicated service meter reading.

Perform previous interval items at multiples of the original requirement. For example, at 100 service hours or 2 weeks, also perform those items listed under "Every 50 Service Hours or Weekly" and "Every 10 Service Hours or Daily".



Service Meter

Some photographs in this publication may show details or attachments that may be different from your unit. Also, the ROPS, for some photographs, has been removed for illustrative purposes.

Continuing improvement and advancement of product design may cause changes to your machine which may not be included in this publication. Each publication is reviewed and revised, as required, to update and include these changes in later editions.

Whenever a question arises regarding your Caterpillar product, or this publication, please consult your Caterpillar dealer for the latest available information.

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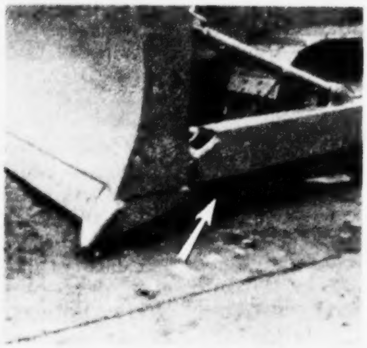
SAFETY

⚠ **THIS SYMBOL WARNS OF POSSIBLE PERSONAL INJURY OR PROPERTY DAMAGE.**

Lower all equipment before servicing hydraulic system.



Block blade before changing cutting edge or end bits.

Use caution when removing radiator cap, drain plugs, grease fittings or pressure taps.

⚠ **WARNING**

To avoid possible weakening of the ROPS (Rollover Protection structure), consult a Caterpillar dealer before altering the ROPS in any way. The protection offered by the ROPS will be impaired if it has been subjected to structural damage or has been involved in an overturn incident.

Do not attempt adjustments while tractor is moving or the engine running.

Wear gloves when handling cable.

Use the proper tools. Replace or repair broken or damaged equipment.

Wear safety glasses and shoes as the job requires.

Do not attempt repairs you do not understand.

⚠ **WARNING**

When using pressure air wear safety glasses and protective clothing. Maximum air pressure must be below 30 PSI (2 kg/cm²).

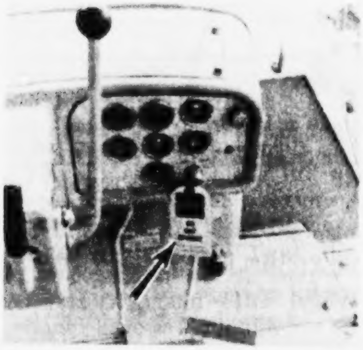
Store oily rags or other combustible material in a safe place.

Operate engine only in well ventilated area.

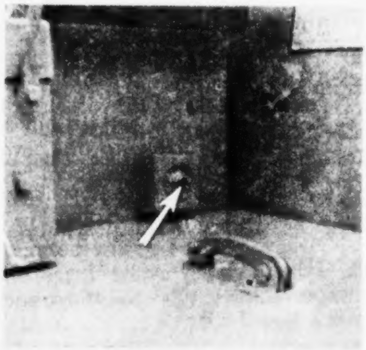
Promote good housekeeping. Keep tools and work area clean.

Do not allow unauthorized personnel on tractor when it is being serviced.

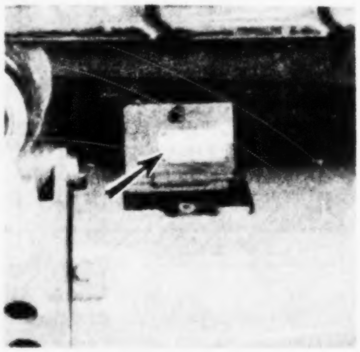
Do not smoke while refueling.



Attach warning tags to controls while tractor is being serviced.



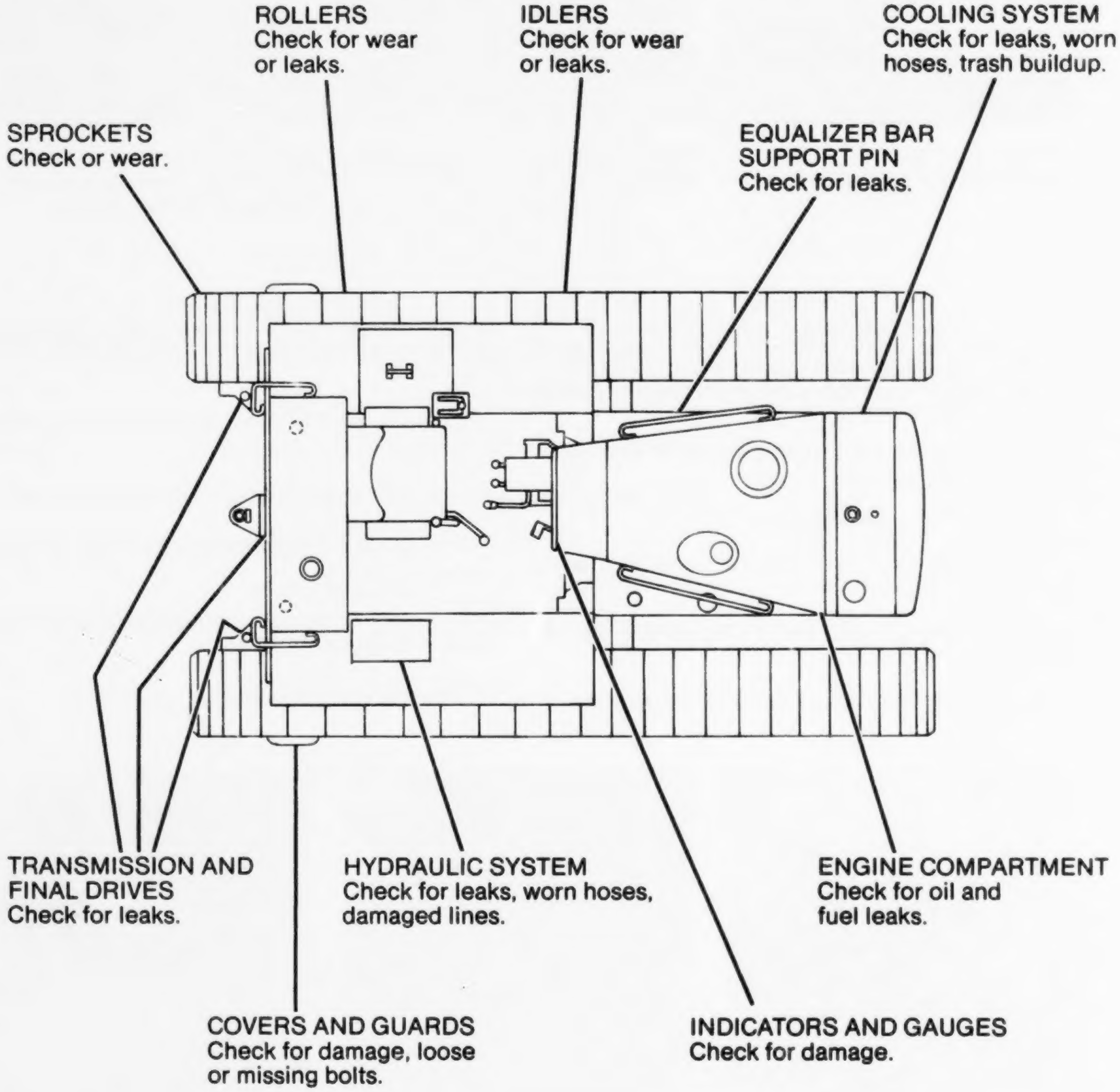
Turn disconnect switch OFF and remove key before servicing electrical system.



Read warning and caution information provided on the tractor. Follow servicing instructions carefully.

WALK-AROUND CHECKS

For maintenance and operator personnel safety, and maximum service life of the machine, make a thorough walk-around inspection when doing lubrication and maintenance work. Check under and around for such items as loose bolts, trash build-up, oil or coolant leaks.


ROLLERS
Check for wear or leaks.
IDLERS
Check for wear or leaks.
COOLING SYSTEM
Check for leaks, worn hoses, trash buildup.
SPROCKETS
Check or wear.
EQUALIZER BAR SUPPORT PIN
Check for leaks.
TRANSMISSION AND FINAL DRIVES
Check for leaks.
HYDRAULIC SYSTEM
Check for leaks, worn hoses, damaged lines.
ENGINE COMPARTMENT
Check for oil and fuel leaks.
COVERS AND GUARDS
Check for damage, loose or missing bolts.
INDICATORS AND GAUGES
Check for damage.

FUEL AND LUBRICANT SPECIFICATIONS

NOTE

The abbreviations listed below follow S.A.E. J754 nomenclature. The classifications follow S.A.E. J183 classifications. The MIL specifications are U.S.A. Military Specifications. These definitions will be of assistance in purchasing. The specific classifications for this engine are found on the "RECOMMENDED LUBRICANTS" chart.

Diesel Fuel

Use only distillate fuels (ASTM No. 1 or No. 2 Fuel Oil or No. 1D or No. 2D Diesel Fuel Oil) with a minimum cetane number of 35. Heavier oil is generally preferable because of its higher energy content. Contact your Caterpillar dealer regarding fuels marketed in your area.

Engine Oils (EO)

CD - Use oils that meet Engine Service Classification **CD** or MIL-L-2104C.

CC - Use oils that meet Engine Service Classification **CC,** MIL-L-2104B or MIL-L-46152.

EO - **CD** or **CC**.

Lubricating Grease (MPGM)

Use Multipurpose-type Grease (**MPGM**) which contains 3-5% molybdenum disulfide conforming to MIL-M-7866, and containing a suitable corrosion inhibitor. NLGI No. 2 Grade is suitable for most temperatures. Use NLGI No. 0 or No. 1 Grade for extremely low temperatures.

Hydraulic Oil (HYDO)

Use (**EO**) or industrial-type hydraulic oils (**HYDO**) which are certified by the supplier as having anti-wear, anti-foam, anti-rust and anti-oxidation additive properties for heavy duty use.

Multipurpose-type Gear Lubricant (MPL)

Use Gear Lubricant Classification GL-5, or MIL-L-2105B.

RECOMMENDED LUBRICANTS
AT STARTING TEMPERATURES FROM −10°F (−23°C) to +120°F (+48°C)[1]

COMPARTMENT OR SYSTEM	STARTING TEMPERATURES	
	ABOVE 32°F A (0°C)	BELOW 32°F (0°C)
	CD	
Engine Crankcase	SAE 30	SAE 10W[2]
Transmission, Bevel Gear and Steering Clutches	SAE 30	SAE 10W
Winch Oil Sump	SAE 30	SAE 10W
Cable Control Gear Case	SAE 30	SAE 10W
Track Rollers and Idlers	SAE 30	SAE 30
	HYDO	
Hydraulic System	SAE 10W	SAE 10W
	EO	
Final Drives	SAE 50	SAE 30
	MPL	
Equalizer Bar Support Pin	SAE 90	SAE 90
Sealed and Lubricated Track	SAE 90	SAE 90

[1] Below −10°F (−23°C) consult your Caterpillar dealer for Cold Weather Recommendations.

[2] SAE 10W oil may be used in the diesel engine even if daytime ambient temperature rises to 70°F (21°C). Below −10°F (−23°C) it may be necessary to warm the engine oil so the engine can be cranked and the oil will circulate freely.

Key to Lubricants:

CD	- Engine Service Classification **CD**, or MIL-L-2104C
CC	- Use oils that meet Engine Service Classification CC, MIL-L-2104B or MIL-L-46152
EO	- **CD** or **CC**
MPL	- GL-5 or MIL-L-2105B
HYDO	- **EO**, or certified Industrial-type Hydraulic Oils
MPGM	- Multipurpose-type Grease with 3 to 5% Molybdenum Disulfide.

LUBRICATION AND MAINTENANCE CHART

ITEM	SERVICE	LUBRICANT	MAINTENANCE	PAGE NO.
EVERY 10 SERVICE HOURS OR DAILY				
① Engine crankcase	Check oil level			9
② Radiator	Check coolant level		●	9
EVERY 50 SERVICE HOURS OR WEEKLY				
③ Ripper linkage	Lubricate 12 fittings	MPGM		9
EVERY 100 SERVICE HOURS OR 2 WEEKS				
④ Cable control sheave bearings	Lubricate 6 fittings	MPGM		10
⑤ Hydraulic control system(1)	Check oil level	HYDO		10
⑥ Batteries	Check electrolyte level		●	10
EVERY 250 SERVICE HOURS OR MONTHLY				
⑦ Engine crankcase	Change oil(2) and filter element, wash breather	CD	●	11
⑧ Transmission, bevel gear and steering clutch compartment(4)	Change filter elements and wash magnetic strainer	CD	●	11
⑨ Bulldozer cylinder support and upper trunnion bearings	Lubricate 6 fittings	MPGM		12
⑩ Track roller frame inner bearings	Lubricate 2 fittings	MPGM		13
⑪ Fan and adjusting pulley bearings	Lubricate 2 fittings	MPGM		13
⑫ Bulldozer tilt brace	Lubricate 2 fittings	MPGM		13
⑬ Cable control shroud bearings	Lubricate 6 fittings	MPGM		13
⑭ Cable control clutch lever rollers	Lubricate 2 fittings	MPGM		13
⑮ Cable control lever shaft and brake lever bearings	Lubricate 4 fittings	MPGM		14
⑯ Parking brake lever	Check to see if it engages		●	14
⑰ Steering clutch brakes	Check — adjust if necessary		●	14
⑱ Fan and alternator belts	Check — adjust if necessary		●	15
EVERY 500 SERVICE HOURS OR 3 MONTHS				
⑲ Hydraulic control system(4)	Change filter elements	HYDO	●	15
⑳ Winch magnetic strainer	Wash magnetic strainer		●	16
㉑ Winch filter	Change filter		●	16
EVERY 1000 SERVICE HOURS OR 6 MONTHS				
㉒ Transmission, bevel gear and steering clutch compartment(3)	Change oil and plastic breathers	CD	●	16
㉓ Final drives	Change lubricant — filter element — breather	EO		17
㉔ Winch oil sump	Change oil	CD		17
㉕ Universal joint	Lubricate 2 fittings	MPGM		18

LUBRICATION AND MAINTENANCE CHART

ITEM	SERVICE	LUBRICANT	MAINTENANCE	PAGE NO.
EVERY 1000 SERVICE HOURS OR 6 MONTHS (Continued)				
㉖ Cable control fairlead sheave lower bearings	Lubricate 2 fittings	MPGM		18
㉗ Cable control	Wash breather		●	18
㉘ Winch breather	Change plastic breather		●	18
EVERY 2000 SERVICE HOURS OR 1 YEAR				
㉙ Hydraulic control system	Change oil — wash filler screen	HYDO		19
㉚ Cable control gear case	Change oil	CD		19
㉛ Engine valve lash	Check — adjust if necessary		●	20
㉜ Cooling system	Renew coolant antifreeze solution		●	23
WHEN REQUIRED				
㉝ Transmission, bevel gear, and steering clutch compartment	Check oil level if leakage develops or is suspected	CD		24
㉞ Torque divider suction screen	Clean when oil becomes thick or at time of repairs on brakes, transmission or torque divider		●	24
㉟ Cable control	Check oil level if leakage develops or is suspected, adjust brake and clutch if necessary and check condition of cable	CD	●	25
㊱ Winch	Check oil level if leakage develops or is suspected and check condition of cable		●	27
㊲ Final drives	Check lubricant level if leakage develops or is suspected	EO		28
㊳ Track	Make adjustment if track sag is not 1½" to 2"		●	28
㊴ Prescreen	Check — clean if necessary		●	29
㊵ Engine air inlet system	Clean when RED band in indicator locks in visible position		●	30
㊶ Cooling system	Drain and clean when engine overheats or solution is dirty		●	33
㊷ Fuel system	Change filter when fuel gauge registers OUT with engine running		●	34
㊸ Fuel tank	Drain moisture and sediment, wash cap whenever engine misfires or frequent fuel filter replacement is required		●	35
㊹ Hydraulic cylinders	Make rod packing adjustment if leakage develops or is suspected		●	35
㊺ Ripper tips	Change ripper tips if damaged or worn		●	36

LUBRICATION AND MAINTENANCE CHART

ITEM	SERVICE	LUBRICANT	MAINTENANCE	PAGE NO.
WHEN REQUIRED (Continued)				
㊻ Bulldozer ball sockets	Make adjustment if brace is too loose		●	36
㊼ Cutting edge and end bits	Change cutting edge and use new end bits, if worn		●	37

(1)Check frequently if any signs of leakage develop or are suspected.

(2)Normal change interval when sulphur content is 0.4% or less. When sulphur content is 0.4% to 1.0%, reduce oil change interval one-half. When sulphur content is above 1.0%, reduce oil change to one-fourth the normal interval.

(3)Change oil any time it becomes thick and black.

(4)Change earlier if filter indicator shows RED with engine running and oil at operating temperatures.

Key to Lubricants:

CD - Engine Service Classification **CD**, or MIL-L-2104C
CC - Engine Service Classification **CC**, MIL-L-2104B or MIL-L-46152
EO - **CD**, **CC**
HYDO - **EO** or certified Industrial-type Hydraulic Oils
MPGM - Multipurpose-type Grease with 3 to 5% Molybdenum Disulfide

General Service Recommendations

NOTE

The engine cooling system is protected to −20°F (−29°C), with permanent-type antifreeze, when shipped from the factory.

Fill fuel tank at the end of each day of operation to drive out moisture laden air and prevent condensation.

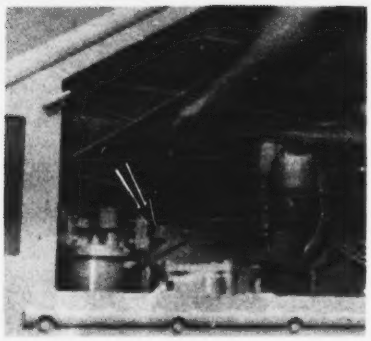
Check fuel level with dipstick in filler opening.

Use clean water that is low in scale forming minerals, not softened water.

Add Caterpillar Corrosion Inhibitor to coolant. Follow recommendation given on container.

EVERY 10 SERVICE HOURS OR DAILY

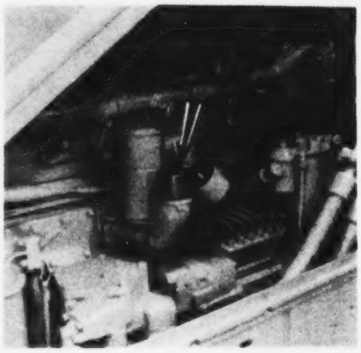
① ENGINE CRANKCASE



1. Check oil level. Machine must be level and brake lock applied. Check can be made . . .

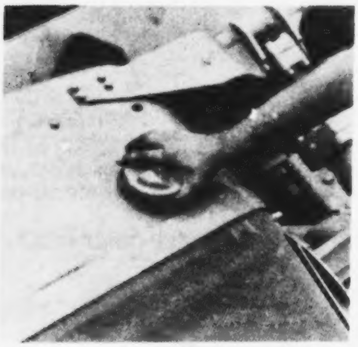
2. . . . before starting. Level must be in SAFE STARTING RANGE on ENGINE STOPPED side of dipstick, or . . .

3. . . . with engine warm and running. Maintain level between ADD and FULL marks on ENGINE RUNNING side of dipstick.

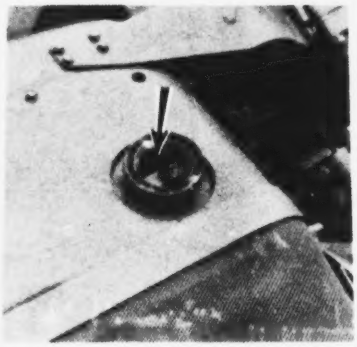


4. Add oil as necessary, through crankcase fill pipe.

② RADIATOR



1. Check coolant level with engine stopped. Remove cap slowly to relieve pressure.

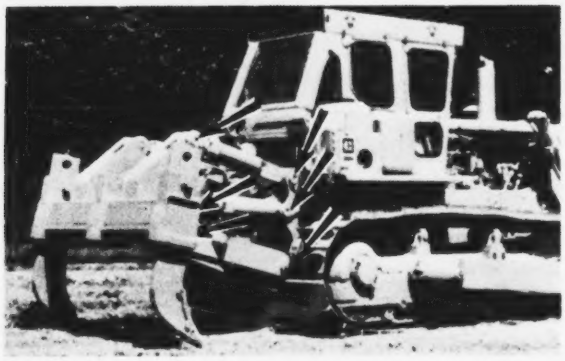


2. Maintain level to within ½ inch (1 cm) of bottom of fill pipe.

3. Use clean water that is low in scale forming minerals, not softened water.

EVERY 50 SERVICE HOURS OR WEEKLY

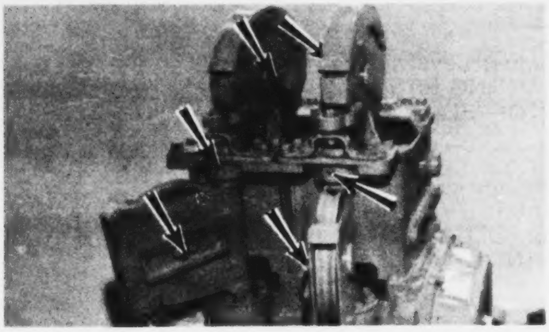
③ RIPPER LINKAGE



Lubricate 12 fittings.

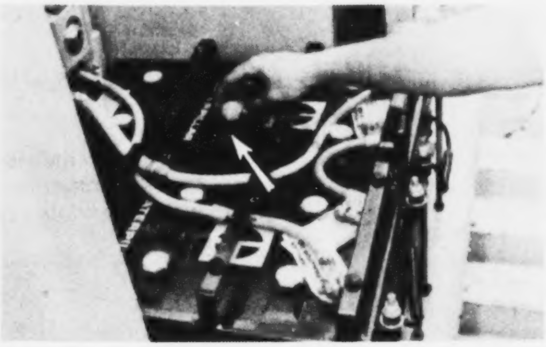
EVERY 100 SERVICE HOURS OR 2 WEEKS

④ CABLE CONTROL SHEAVE BEARINGS



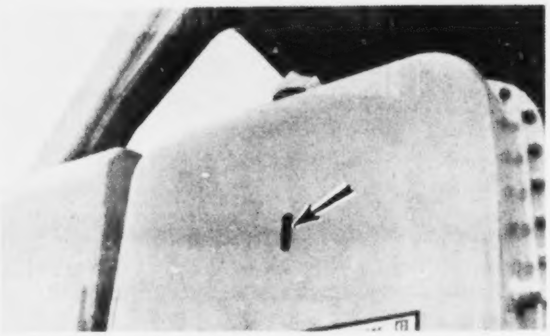
Lubricate 6 fittings.

⑥ BATTERIES



Maintain electrolyte level at triangle in fill plug opening.

⑤ HYDRAULIC CONTROL SYSTEM



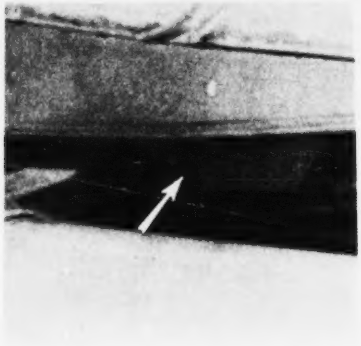
Check oil level with equipment lowered (engine running at low idle, transmission in NEUTRAL, brake lock engaged). Oil should be visible in sight gauge.

NOTE

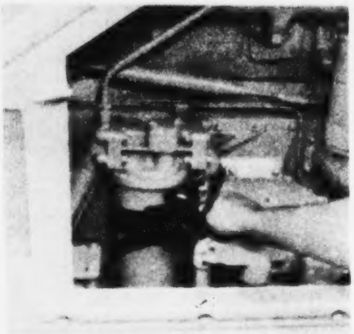
At proper charging rate, batteries will not require more than 1 ounce (30 cc) of water per cell per week. Keep batteries clean.

EVERY 250 SERVICE HOURS OR MONTHLY

⑦ ENGINE CRANKCASE



1. Run engine long enough to warm oil. Park on level ground. Stop engine. Open drain valve and drain oil.



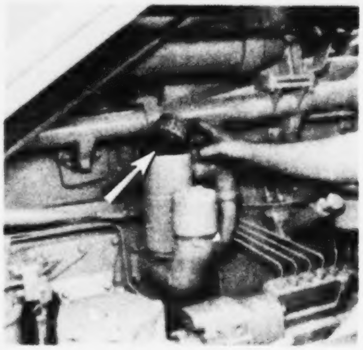
2. Remove old filter.

3. Clean filter base. Make sure all of old gasket is removed.

4. Apply thin film of clean oil to gasket of new filter.

5. Install filter, tighten until gasket contacts base. Tighten filter an additional ¾ turn. Do not overtighten.

6. Close drain valve.



7. Remove breather. Wash breather in clean solvent.

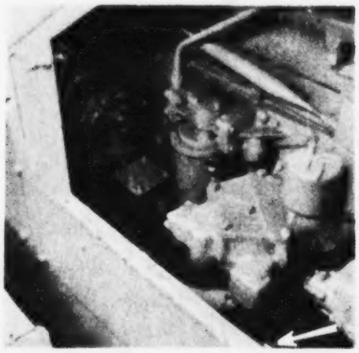
8. Inspect seal, install new seal if necessary. Install breather. Tighten bolt.

9. Fill crankcase. See Refill Capacities.

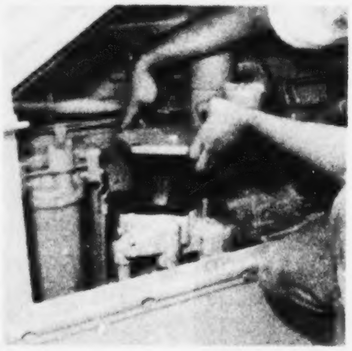
10. Start engine and run at low idle to fill filter housing. Check oil level. Add oil if necessary.

11. Check for leaks.

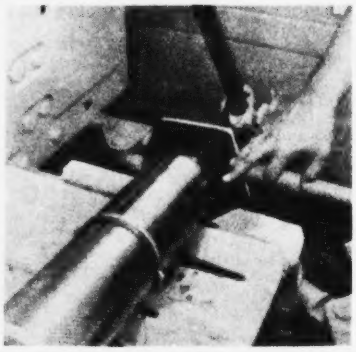
⦿ TRANSMISSION, BEVEL GEAR AND STEERING CLUTCH COMPARTMENT



1. Remove filter plug and allow oil to drain.

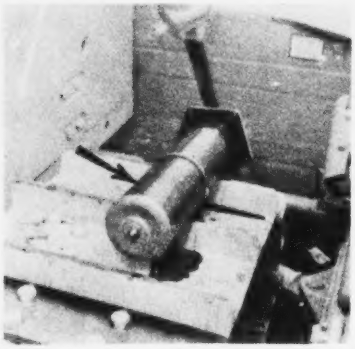


2. Remove cover and old elements.

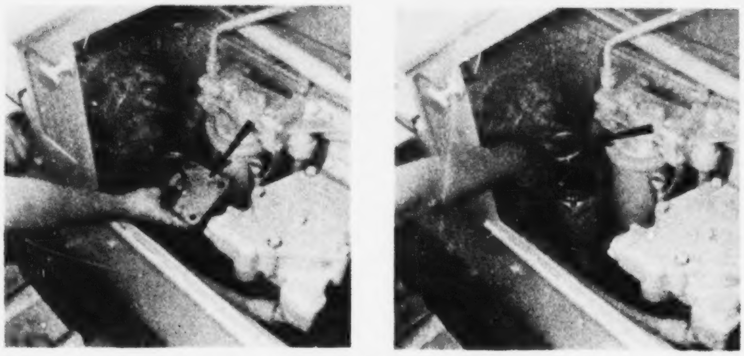


3. Clean cover and inspect seals Install new seals if necessary.

EVERY 250 SERVICE HOURS OR MONTHLY



4. Secure new elements to cover. Install elements, cover and drain plug.



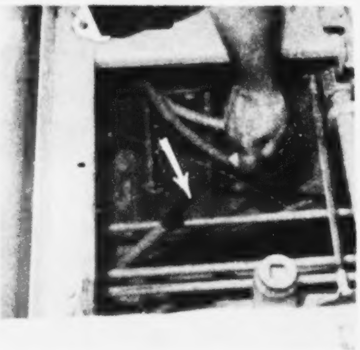
5. Remove cover, spring, screen and magnets from magnetic strainer. Wash screen in clean solvent. Clean magnets with a stiff brush , a clean cloth or pressure air. Do not drop or rap magnets.

⚠ WARNING

When using pressure air wear safety glasses and protective clothing. Maximum air pressure must be below 30 PSI (2 kg/cm²).

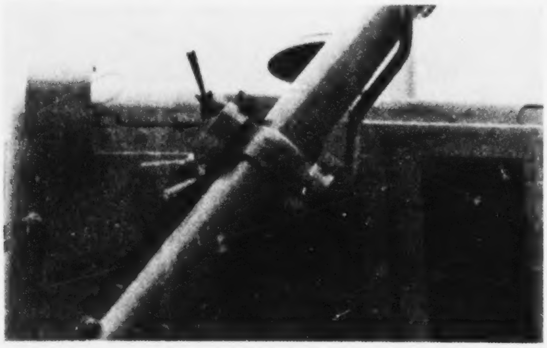
6. Clean cover and check seal. Install new seal if necessary.

7. Install magnets, screen, spring and cover.

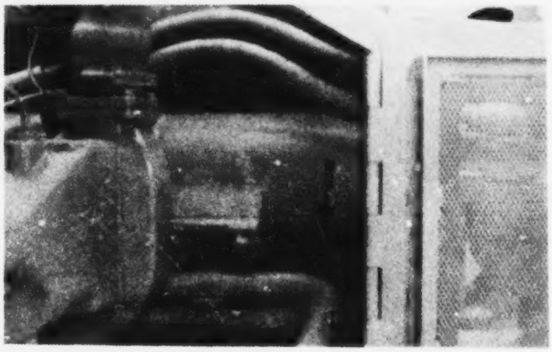


8. Start and run engine at low idle to fill filter. Add oil to bring level to FULL mark on dipstick.

① BULLDOZER CYLINDER SUPPORT AND UPPER TRUNNION BEARINGS

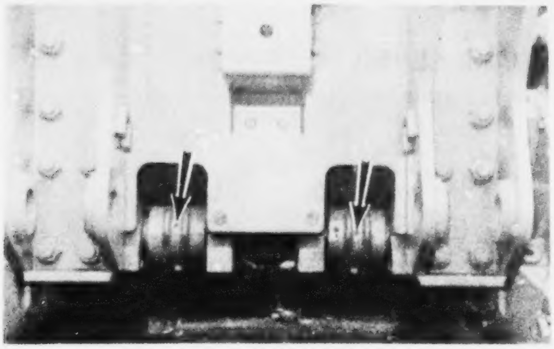


1. Lubricate 2 fittings on each side of tractor. Total 4 fittings.



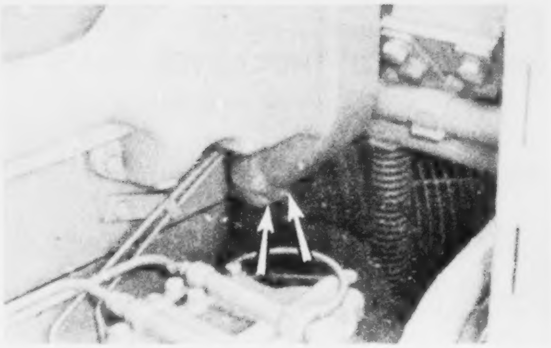
2. Lubricate 1 fitting on each side of tractor, total 2 fittings.

⑩ TRACK ROLLER FRAME INNER BEARINGS



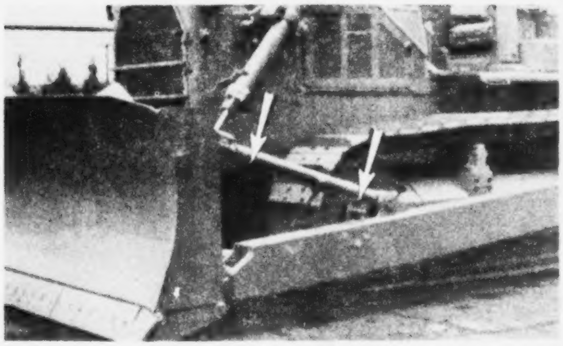
Lubricate 2 fittings.

⑪ FAN AND ADJUSTING PULLEY BEARINGS



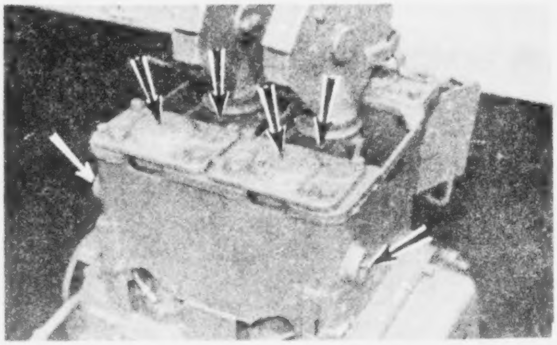
Lubricate 2 fittings.

⑫ BULLDOZER TILT BRACE



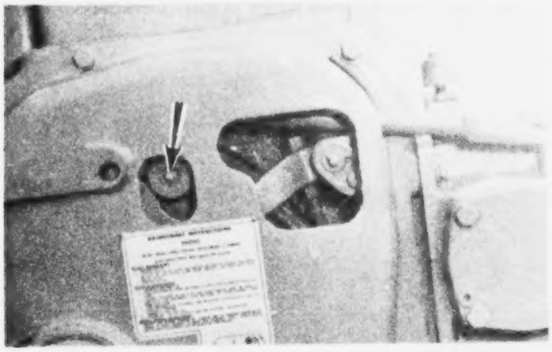
Lubricate 2 fittings.

⑬ CABLE CONTROL SHROUD BEARINGS



Lubricate 6 fittings.

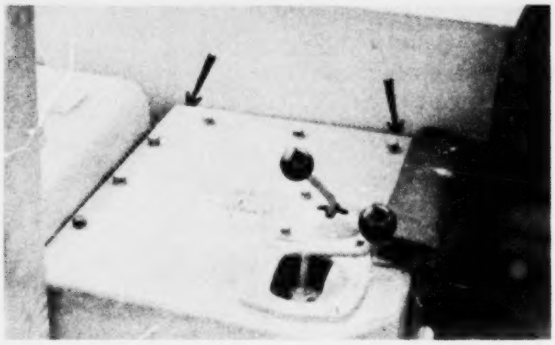
⑭ CABLE CONTROL CLUTCH LEVER



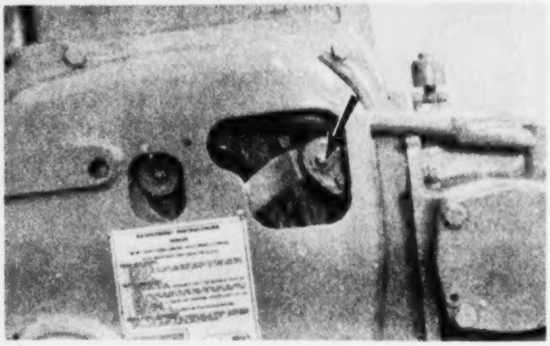
Lubricate 1 fitting on each side of cable control. Total 2 fittings.

EVERY 250 SERVICE HOURS OR MONTHLY

⑮ CABLE CONTROL LEVER SHAFT AND BRAKE LEVER BEARINGS

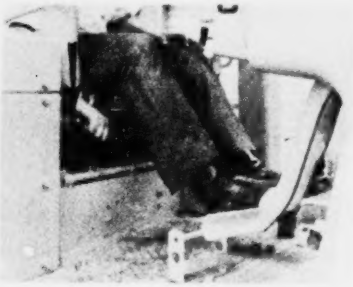


Lubricate 2 fittings.



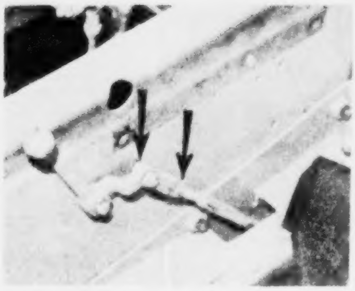
Lubricate 1 fitting on each side of cable control. Total 2 fittings.

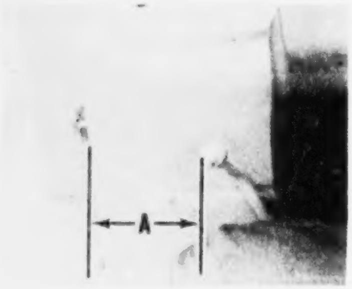
⑯ PARKING BRAKE LEVER



Check to see that parking brake lever engages properly. If it does not, adjust lever linkage.

To Adjust:



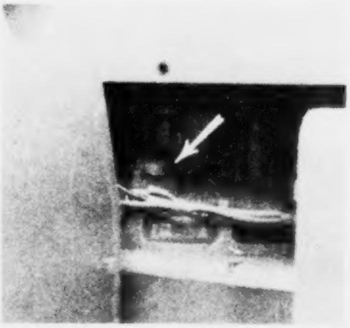


Disengage brake lever. Disconnect lever. Loosen nut and adjust length of rod so that dimension "A" is 4 inches (101,6 mm). Tighten nut and connect lever. If tractor is not equipped with a console,lever should be 3.5 inches (88,9 mm) from front edge of seat frame.

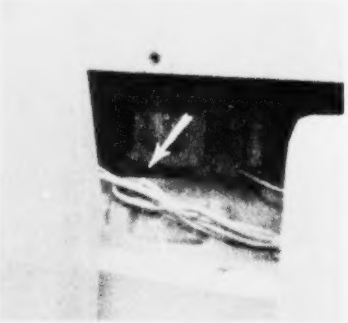
⑰ STEERING CLUTCH BRAKES

Check adjustment. Adjust brakes when pedal travel reaches 6 to 6½ inches (150 to 165 mm).

To Adjust:



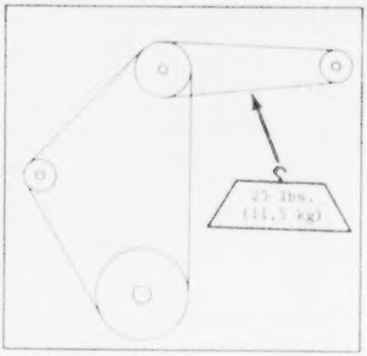
1. Remove guard and cover.



2. Turn adjusting screw in until tight (brake band tight against brake drum). Back screw out 1½ turns (9 clicks).

⑱ FAN AND ALTERNATOR BELTS

1. Check condition of belts. Always install a matched set of belts when any belt requires replacement.

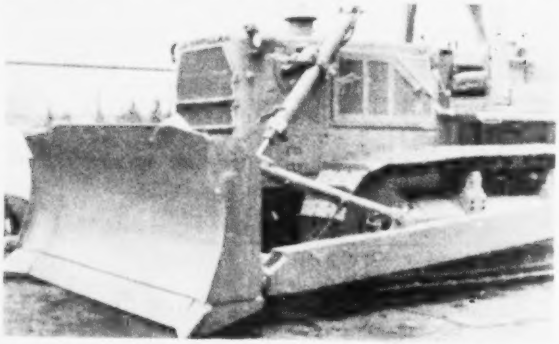


2. Check alternator belt. Correct adjustment allows approximately ¾ inch (19 mm) deflection.

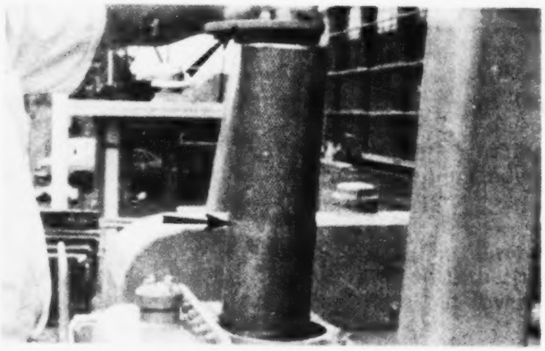
To adjust alternator belt: Loosen mounting bolts and move alternator to obtain correct adjustment. Tighten mounting bolts.

EVERY 500 SERVICE HOURS OR 3 MONTHS

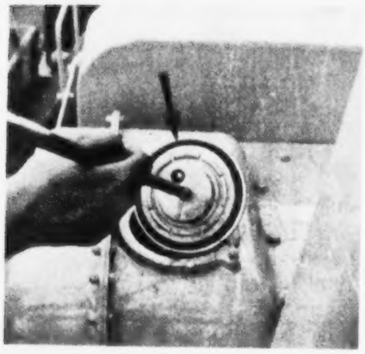
⑲ HYDRAULIC CONTROL SYSTEM



1. Lower all equipment and stop engine.



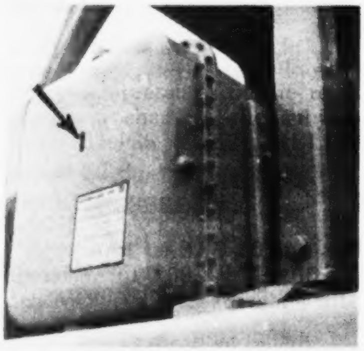
2. Remove cover and old element.



3. Check cover seal. Install new seal if necessary.

4. Install new element. Install cover.

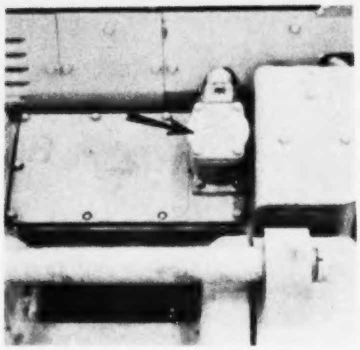
5. Start engine and operate at low idle.



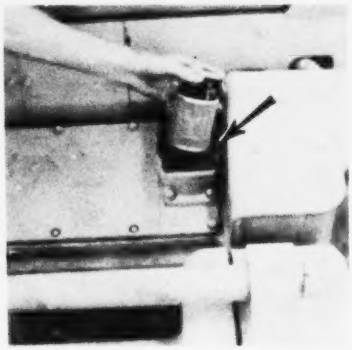
6. Check oil level. Oil should be visible in sight gauge. Add oil as required.

EVERY 500 SERVICE HOURS OR 3 MONTHS

⑳ WINCH MAGNETIC STRAINER

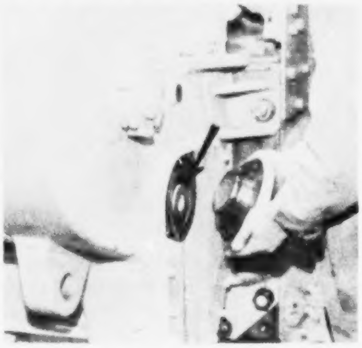


1. Remove cover and strainer. Wash strainer in clean solvent.



2. Install strainer. Inspect seal. Install a new seal if necessary. Install cover.

㉑ WINCH FILTER

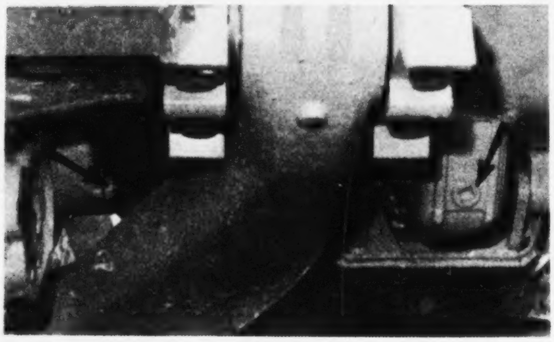


1. Remove cover and filter element. Install new element.

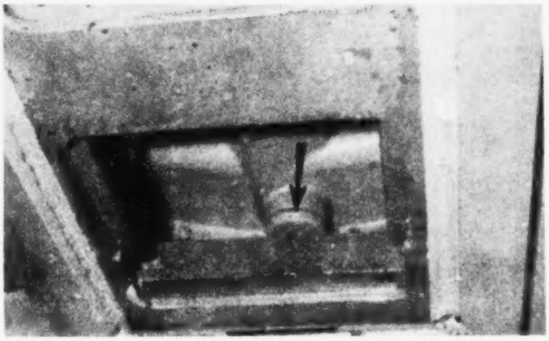
2. Inspect seal. Install a new seal if necessary. Install cover.

EVERY 1000 SERVICE HOURS OR 6 MONTHS

㉒ TRANSMISSION, BEVEL GEAR AND STEERING CLUTCH COMPARTMENT



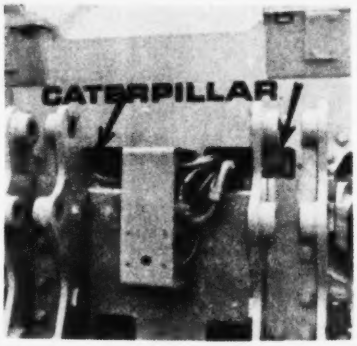
1. Oil should be warm before draining. Remove bevel gear drain plug. Remove steering clutch drain plugs (one each side).



2. Remove converter drain plug.

3. Change filter elements. Wash magnetic strainers. See Item ①.

4. Install all drain plugs.

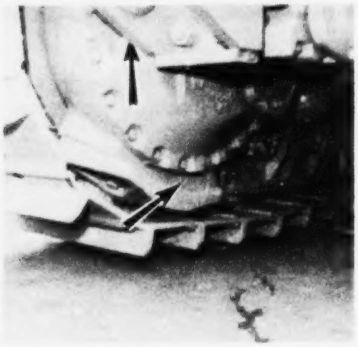


5. Remove 2 breathers and install new ones.

6. Fill compartment. See REFILL CAPACITIES. Start engine and check oil level. Oil should be up to FULL mark on dipstick.

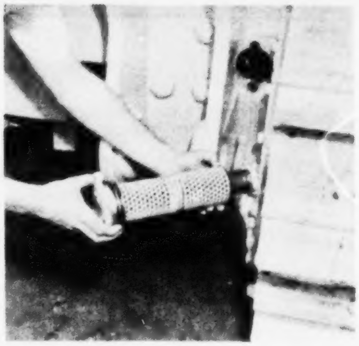
7. Install fill cap.

㉓ FINAL DRIVES



1. Remove fill and drain plugs (one each side) and allow oil to drain.

2. Remove covers and filter elements.



3. Remove old elements from covers and install new elements on covers.

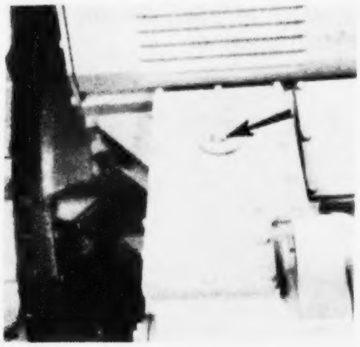
4. Check seal. Use new one if necessary.

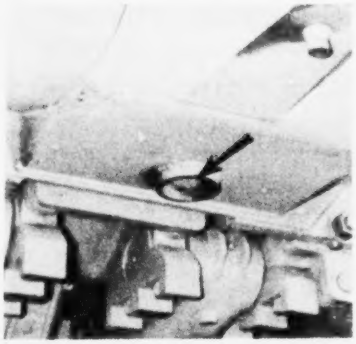
5. Install new filter elements and covers.

6. Install drain plugs and fill compartment. See Refill Capacities. Install fill plugs.

7. Remove and discard breather. Install new breather.

㉔ WINCH OIL SUMP



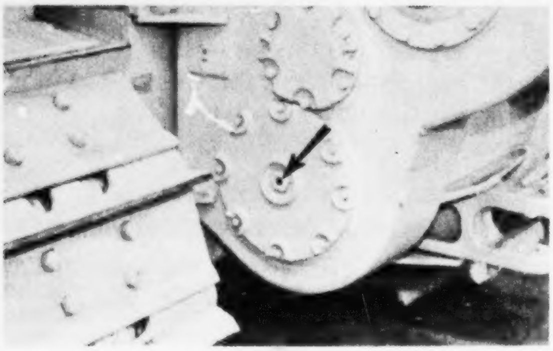


3. Fill compartment until oil is visible in the sight gauge. See REFILL CAPACITIES. Clean and install fill plug.

1. Remove fill and drain plugs. Allow oil to drain. Do items ⑳ and ㉑.

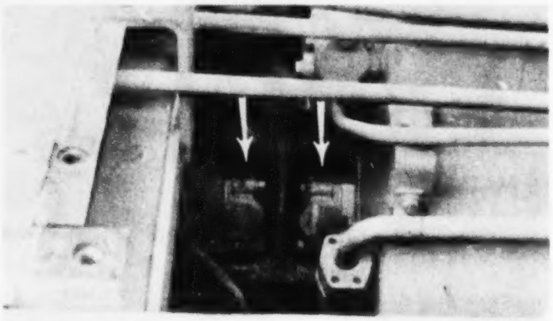
2. Clean and install drain plug.

EVERY 1000 SERVICE HOURS OR 6 MONTHS



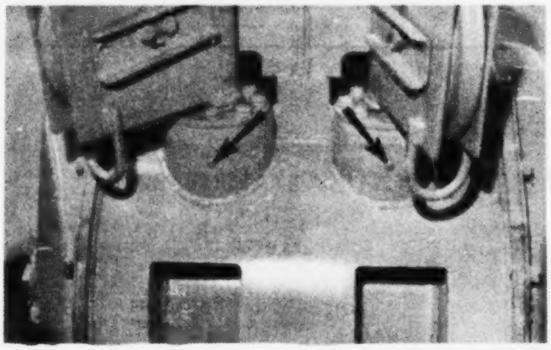
4. Start engine and operate at low idle. Check oil level with engine running at low idle. Oil level must be visible in sight gauge.

㉕ UNIVERSAL JOINT



Remove floor plate and lubricate 2 fittings.

㉖ CABLE CONTROL FAIR-LEAD SHEAVE LOWER BEARINGS

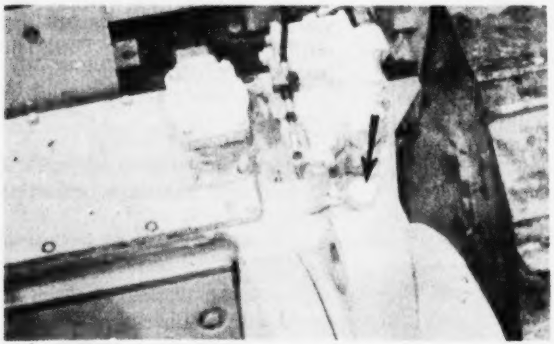


Remove plugs and install 2 fittings. Lubricate 2 fittings, remove fittings and install plugs.

㉗ CABLE CONTROL

Remove breather. Wash in clean solvent. Lightly oil element and install breather.

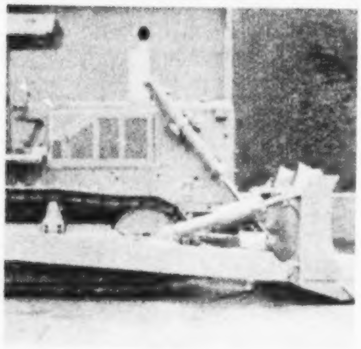
㉘ WINCH BREATHER



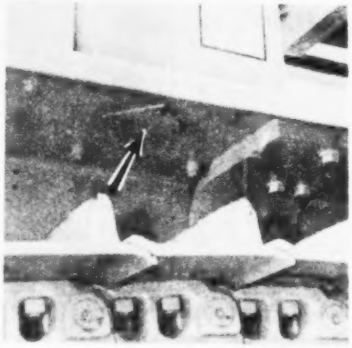
Remove and discard breather. Install a new breather.

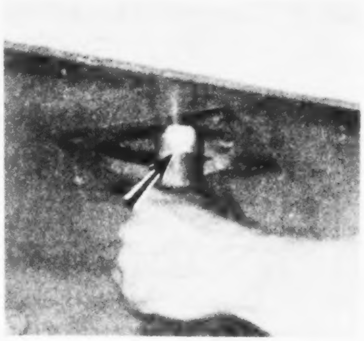
EVERY 2000 SERVICE HOURS OR 1 YEAR

㉙ HYDRAULIC CONTROL SYSTEM



1. Position tractor on level ground. Lower all equipment.



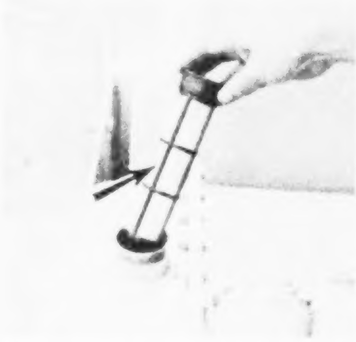


2. Stop engine and remove fill plug. Remove plate under fender and remove drain plug. (Insert a 1 inch (25,4 mm) pipe nipple, approximately 6 inches (152 mm) long, into drain to relieve check valve. Allow oil to drain.

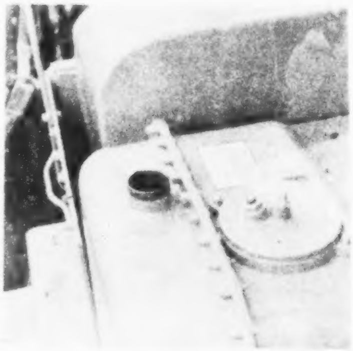
⚠ WARNING
Extreme caution should be used, oil can be hot and may cause personal injury.

3. Remove pipe nipple and install drain plug and plate.

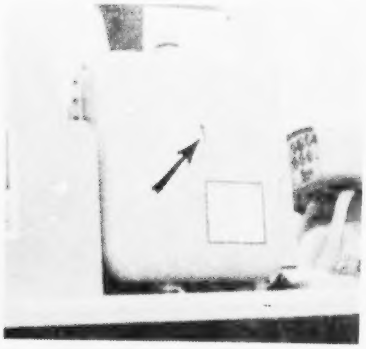
4. Change filter element. See Item 19.



5. Remove filler strainer. Wash strainer in clean solvent. Install strainer.



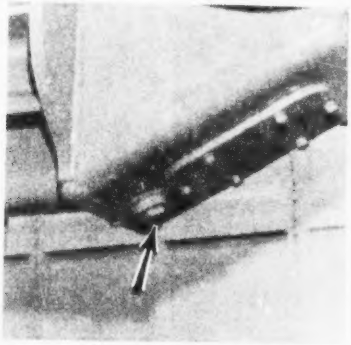
6. Add oil to tank until it is visible in sight gauge. See REFILL CAPACITIES.



7. Check oil level.

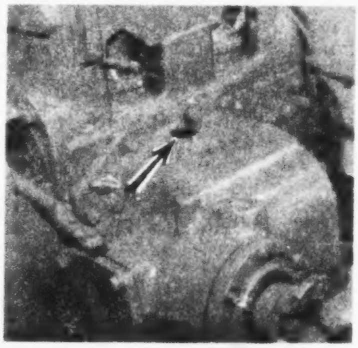
8. Clean and install filler cap.

㉚ CABLE CONTROL GEAR CASE



1. Remove fill and drain plugs. Allow oil to drain.

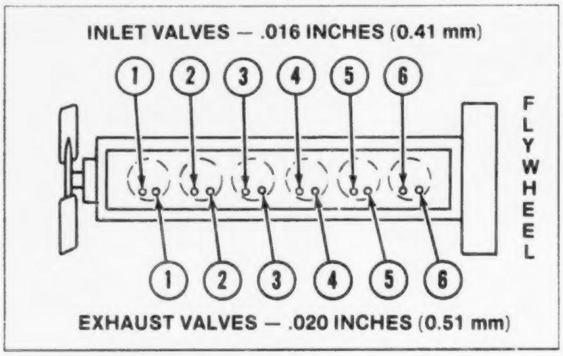
2. Clean and install drain plug.



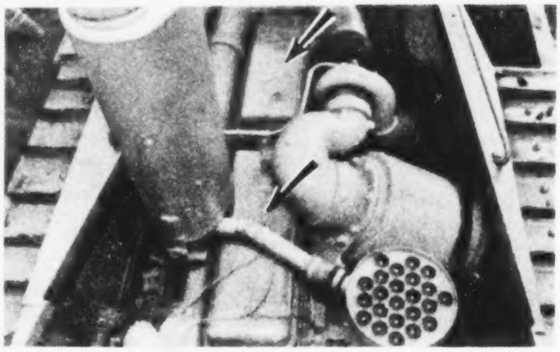
3. Fill gear case with oil to level of fill plug opening. Install fill plug. See REFILL CAPACITIES.

EVERY 2000 SERVICE HOURS OR 1 YEAR

㉛ DIESEL ENGINE VALVE LASH

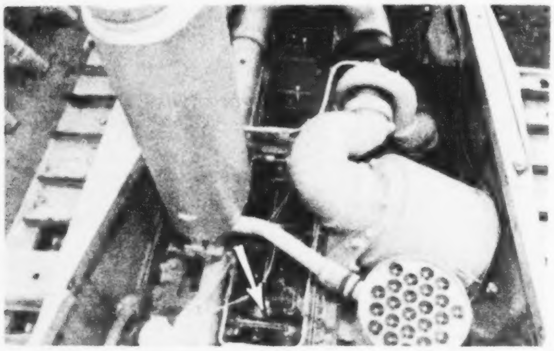

INLET VALVES — .016 INCHES (0.41 mm)
①
②
③
④
⑤
⑥
FLYWHEEL
①
②
③
④
⑤
⑥
EXHAUST VALVES — .020 INCHES (0.51 mm)

Check valve lash with engine stopped.

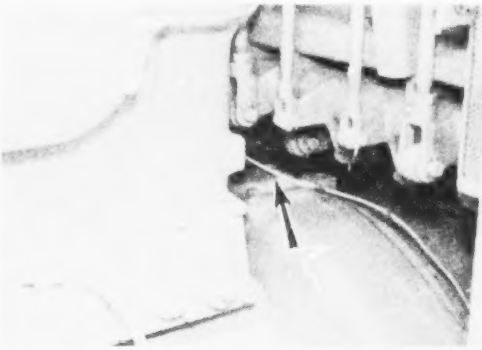


1. Remove valve covers.

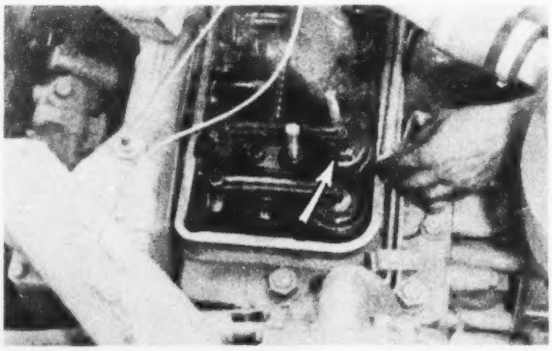
CAUTION
Always turn flywheel in direction of normal rotation.



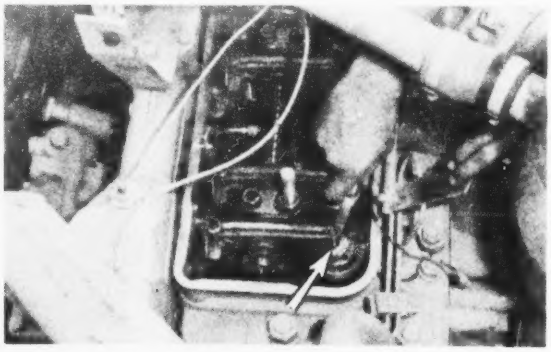
2. Turn flywheel to close No. 1 exhaust and inlet valves.



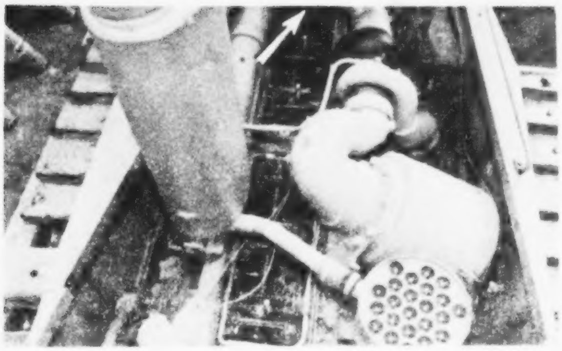
3. Remove cover at the top of the flywheel housing. Indicator should be aligned with the TDC mark on flywheel.



4. Check valve lash for No. 1, No. 3 and No. 5 exhaust valves. Adjust if necessary. See page 22.

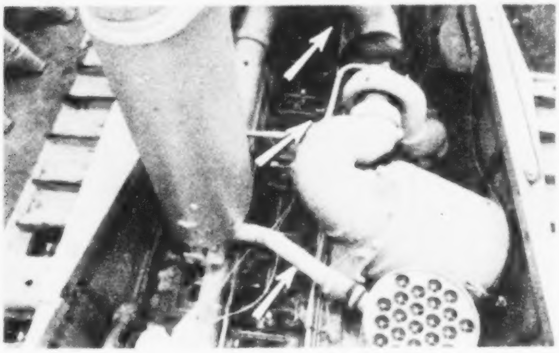


5. Check valve lash for No. 1, No. 2 and No. 4 inlet valves. Adjust if necessary.

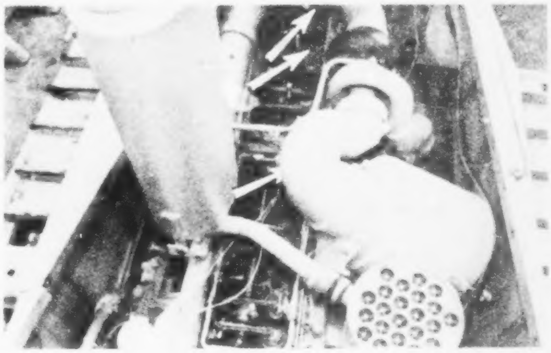


5. Rotate flywheel 360° to close No. 6 exhaust and inlet valves.

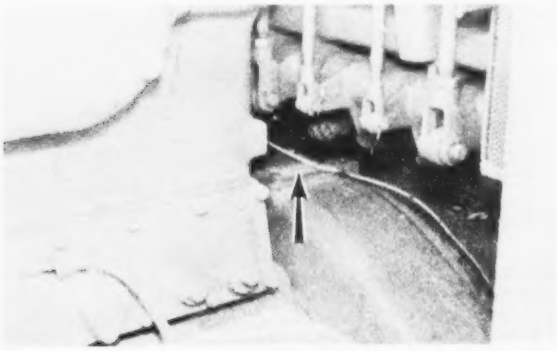
6. Use indicator to assure flywheel is in the correct position.



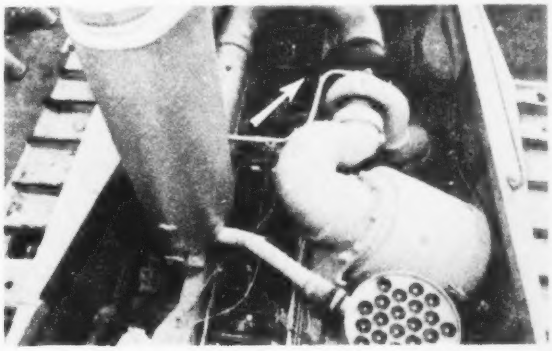
7. Check valve lash for No. 2, No. 4 and No. 6 exhaust valves. Adjust if necessary.



8. Check valve lash for No. 3, No. 5 and No. 6 inlet valves. Adjust if necessary.

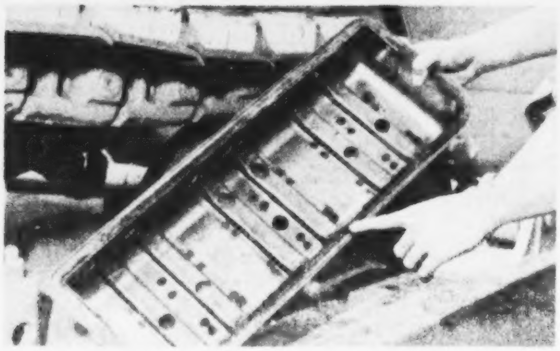


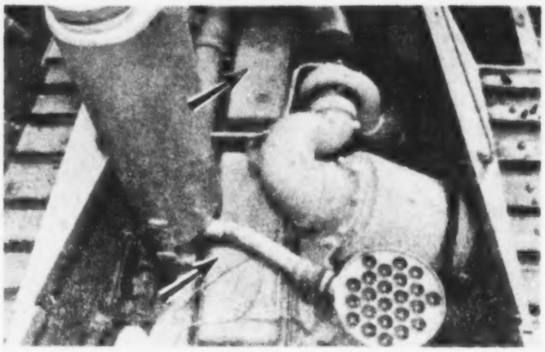
9. Install plate at top of flywheel. Start engine and operate at low idle.



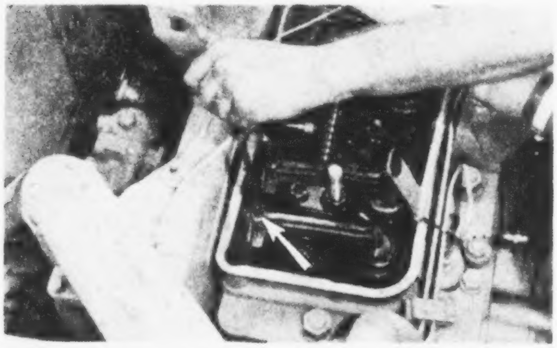
10. Check valve rotation. If valves do not rotate, see your Caterpillar dealer.

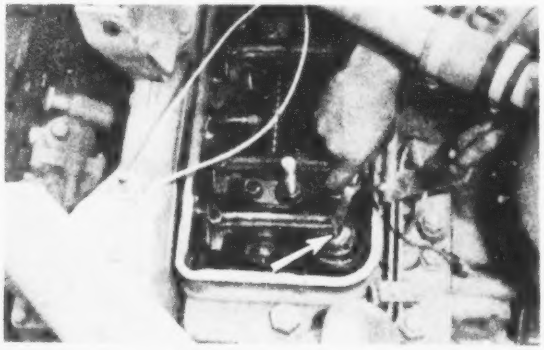
EVERY 2000 SERVICE HOURS OR 1 YEAR

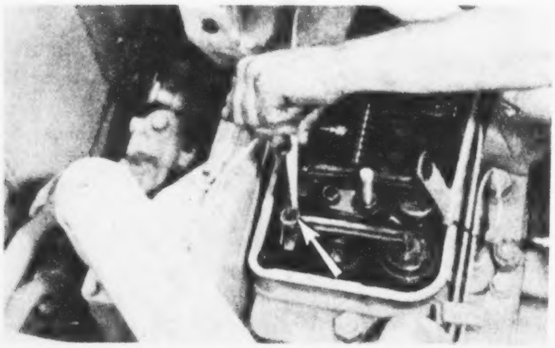

11. Stop engine. Inspect cover gasket, replace if necessary.

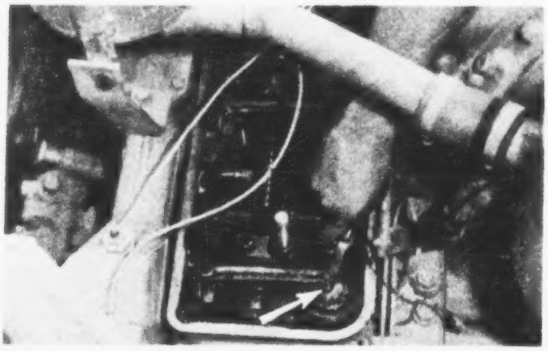

12. Install valve covers, tighten nuts to approximately 25 lb. ft. (3.5 mkg).

Adjusting Valve Lash


1. Loosen locknut and turn adjusting screw.


2. Check adjustment.


3. Tighten locknut.


4. Recheck adjustment.

COOLING SYSTEM — Changing Antifreeze Solution(1)

NOTE

When permanent antifreeze and water solutions are used in the cooling system, the solution should be drained and replaced every 2000 hours, or yearly.

When additions of inhibitor are made to the cooling system every 500 hours, or three months, it is not necessary to drain and refill yearly.

Whenever draining and refilling the cooling system, always recheck the coolant level when the engine reaches normal operating temperature.

Use clean water that is low in scale forming minerals — not softened water.

Check specific gravity of antifreeze solution frequently in cold weather to assure adequate protection.

Add Caterpillar Corrosion Inhibitor. Follow recommendations given on container.

⚠ WARNING

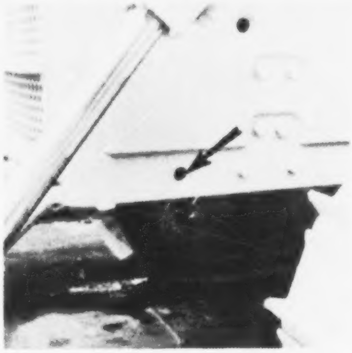
Inhibitor contains alkali, avoid contact with skin and eyes.

NOTE

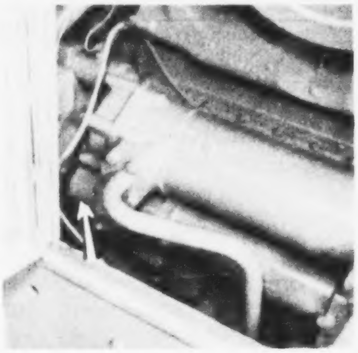
The engine cooling system is protected to −20°F (−29°C), with permanent-type antifreeze, when shipped from the factory.

1. Run engine until coolant is at operating temperature. Park machine on level ground and stop engine.

2. Loosen filler cap slowly to release pressure, and remove filler cap.



3. Open radiator drain valve and allow coolant to drain.



4. Remove transmission — engine oil cooler drain plug and allow coolant to drain.

5. If tractor is equipped with a heater, drain coolant from heater.

6. Close radiator valve and install transmission — engine oil cooler plug.

7. Mix antifreeze solution to provide protection to the lowest expected ambient temperature.

8. Add coolant slowly to proper level.

9. Install radiator filler cap.

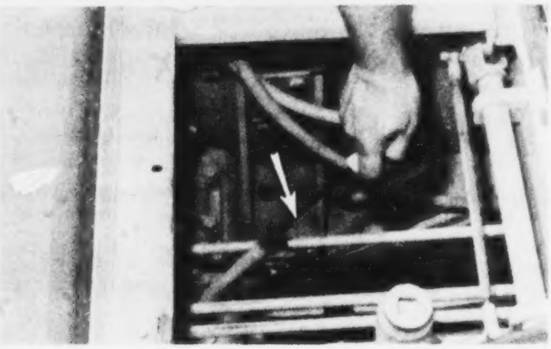
10. Start machine. Recheck level after operating for a short period.

---

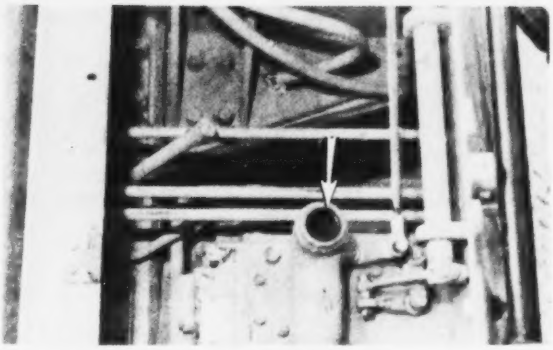
(1) If machine is to be stored in or shipped to an area with below freezing temperatures, cooling system must be drained completely, or protected to lowest expected ambient temperature.

WHEN REQUIRED

㉝ TRANSMISSION, BEVEL GEAR AND STEERING CLUTCH COMPARTMENT



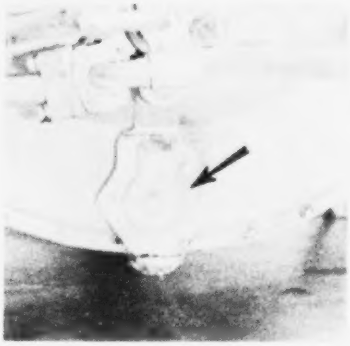
Check oil level with engine at low idle and transmission in NEUTRAL. Maintain oil level between ADD and FULL marks on dipstick.



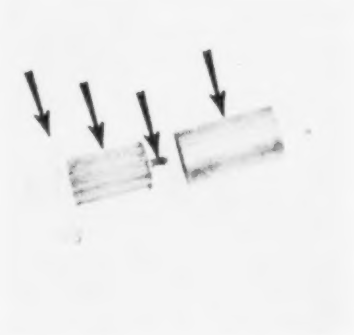
Add oil if required.

㉞ TORQUE DIVIDER SUCTION SCREEN

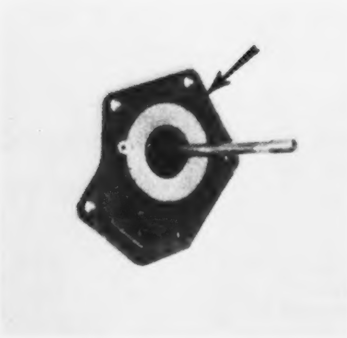
1. Wash suction screen whenever common oil compartment is drained for repairs on brakes, transmission or torque divider.



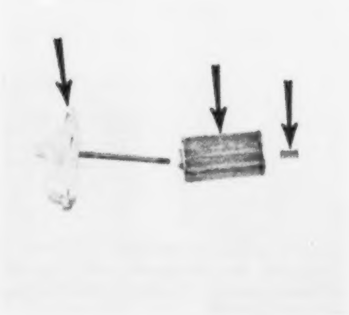
2. Remove cover housing spring and screen.



3. Separate cover, housing spring and screen. Wash screen in clean solvent.



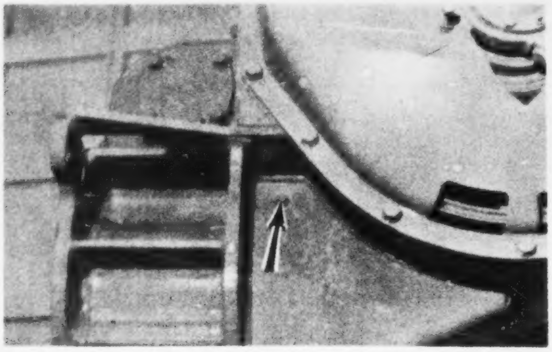
4. Inspect cover gasket. Install new cover gasket if necessary.



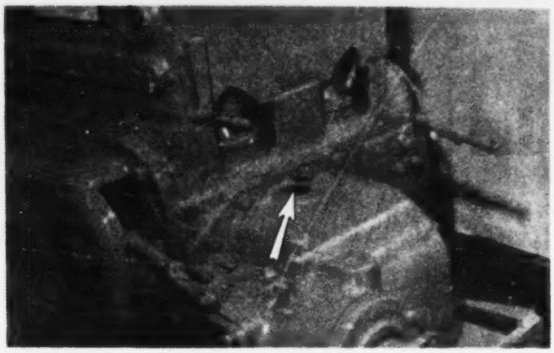
5. Install screen, spring and housing to cover. Be sure pin in housing is aligned with hole in cover.

6. Install suction screen assembly.

㉟ CABLE CONTROL — Checking Oil Level

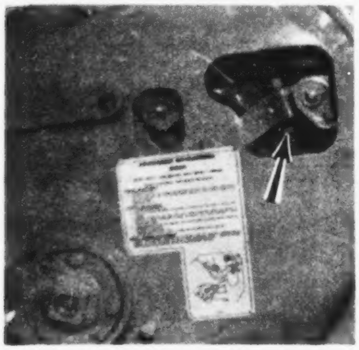


1. Remove check plug.

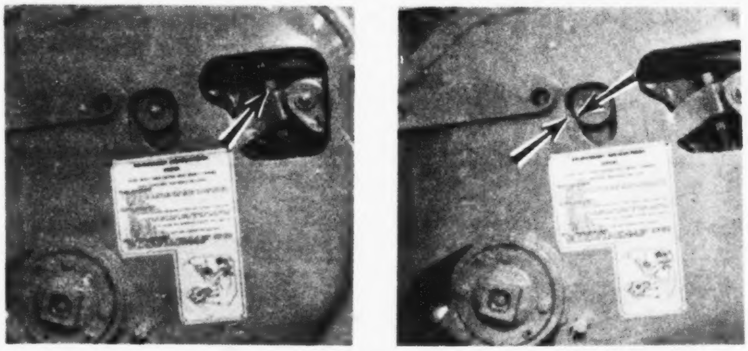


2. Check oil level. Maintain oil level up to the check plug opening. Clean and install check plug.

Brake Adjustment

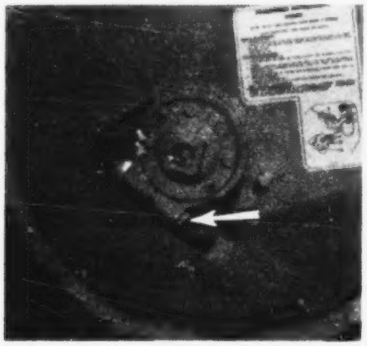


1. Stop engine. Loosen clamp bolt.

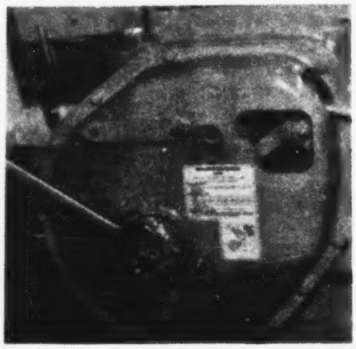


2. Turn adjusting nut to align center of roller and small hole in brake lever. Tighten locknut.

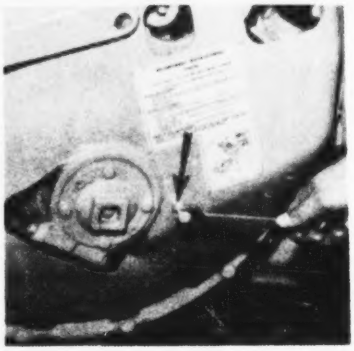
Clutch Adjustment (Adjust brake before adjusting clutch)



1. Stop engine. Loosen locknut.

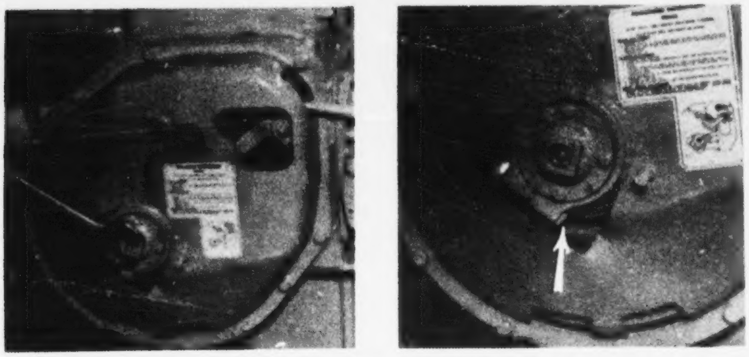


2. Turn adjusting screw counterclockwise until retainer is tight and clutch is engaged.

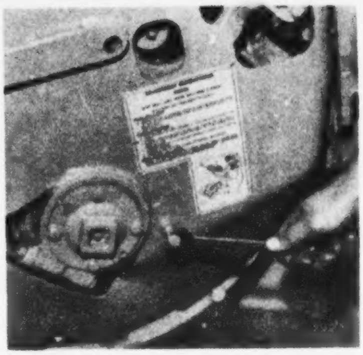


3. Loosen locknut and turn bolt until it contacts pressure plate retainer. Back bolt out 1 turn.

WHEN REQUIRED



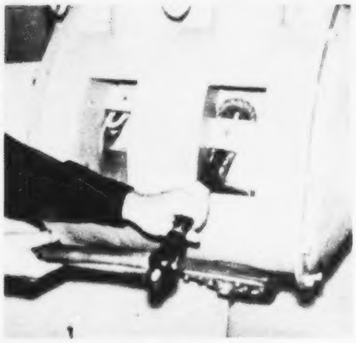
4. Turn adjusting screw until pressure plate retainer contacts bolt. Tighten clamp bolt.



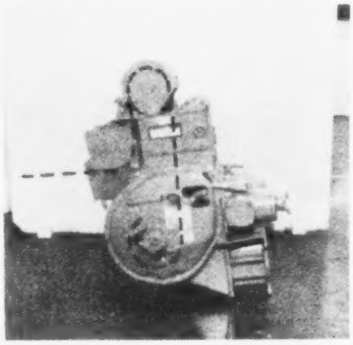
5. Loosen bolt 5 turns. Tighten locknut.

Cable

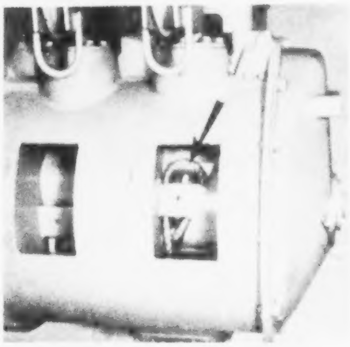
CAUTION
Check cable for frayed or worn spots. If cable is frayed or worn install new cable.



1. Stop engine. Loosen wedge and remove old cable.



2. Thread new cable.

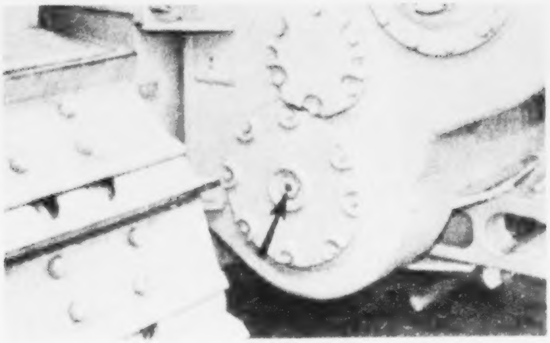


3. Loop end of cable around wedge. Pull cable to tighten wedge.

The recommended cable is: ½", 6 x 25 Filler Wire, Right Lang Lay, Independent Wire Rope Center, Preformed, Improved Plow Steel Type.

MINIMUM AMOUNT OF CABLE ON DRUM		
	RIGHT DRUM	LEFT DRUM
Scraper grounded	5-6 Wraps	
Scraper ejector to rear and apron closed		2 Wraps

㊱ WINCH



NOTE
Check cable. If cable is worn or frayed install a new cable.

1. Check oil level with engine running at low idle. Oil must be visible in sight gauge. Add oil if necessary.

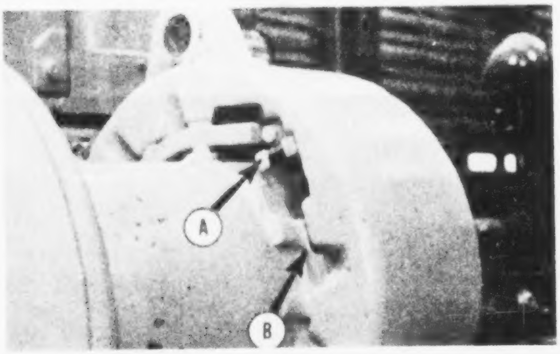
Installing Cable

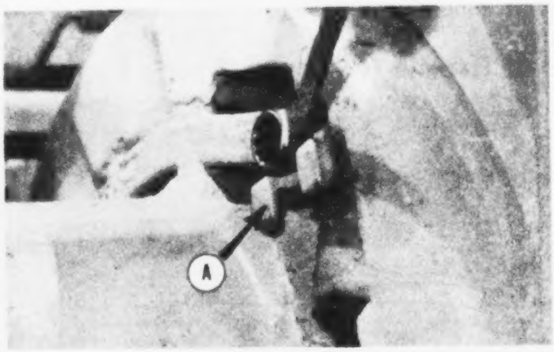
Cable is attached to the drum on the winch with a standard cable ferrule. The ferrule, leaded or wedged to the cable, is fitted into a socket on the drum and secured with a bolt-down clamp.

Ferrules are made in various diameters and lengths. When ordering cable from your local supplier, use the following guide to specify the correct ferrule.

WINCH	CABLE DIAMETER	CABLE FERRULES IN. (mm)		
		Number	Outside Diameter	Length
58	1⅛ (28)	J-9	2⅜ (60)	2¾ (69)
	1¼ (32)	J-10	2⅜ (60)	2¾ (69)

NOTE
1¼ in. (32 mm) diameter cable is to be used for extended cable life only. It is not to be used for increasing winch capacity.



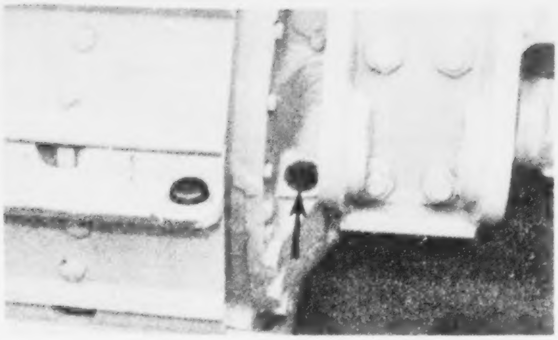


Put the cable in a straight line behind the tractor. Remove clamp (A). Install cable end into groove (B). Install clamp (A).

Spool capacity for the 1⅛ in. (28 mm) diameter cable on the 58 winch with a 13 in. (330 mm) diameter spool is 225 ft. (69 m) or 266 ft. (81 m) with a 9.5 in. (241 mm) diameter spool. Spool capacity for the 1¼ in. (32 mm) diameter cable with a 13 in. (330 mm) diameter spool is 178 ft. (54 m) or 211 ft. (64 m) with a 9.5 in. (241 mm) diameter spool.

WHEN REQUIRED

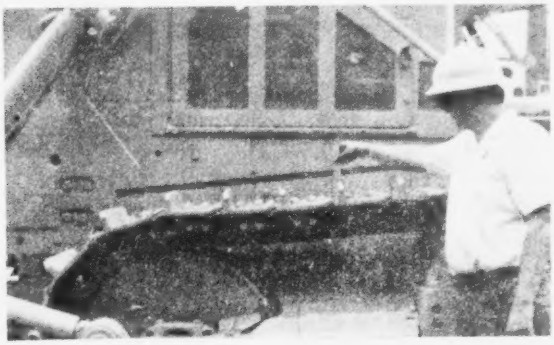
㊲ FINAL DRIVES



1. Remove fill plug.

2. Check oil level. Oil should be up to the filler plug opening. Add oil as required.

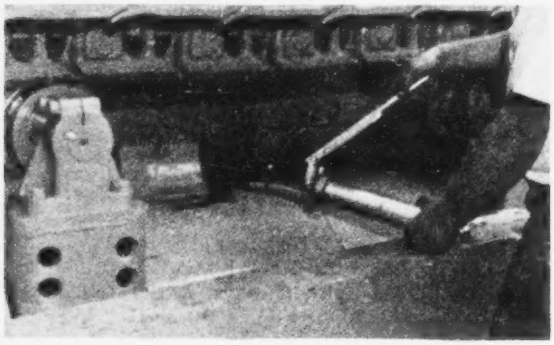
㊳ TRACK



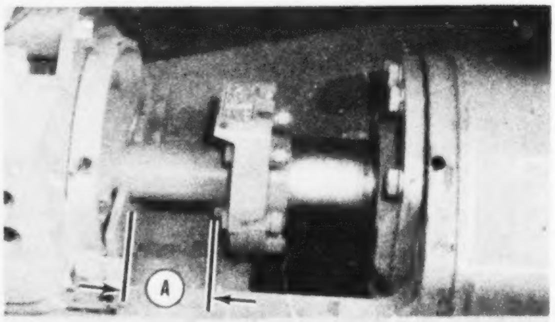
Check adjustment. Correct adjustment allows 1½ to 2 inches (40 to 50 mm) sag at this point.

⚠ WARNING
If track is sealed and lubricated type, secure track with chain before separating links. Sealed and lubricated track is very flexible. When disconnected it can move and cause injury.

If Track is Too Loose:



1. Raise inspection plate and add multipurpose-type grease through fill valve until adjustment is correct.

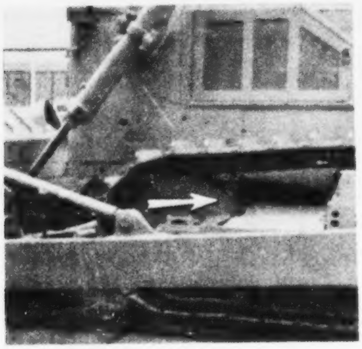


2. Operate tractor back and torth to equalize pressure.

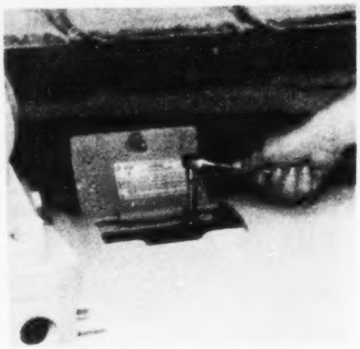
3. Recheck adjustment.

CAUTION
Do not attempt to tighten track when measurement at "A" is less that 1 inch (25 mm). Contact your Caterpillar dealer for track service.

If Track is Too Tight:



1. Be sure front idler can retract. Raise inspection plate.



2. Loosen relief valve 1 turn to allow grease to escape.

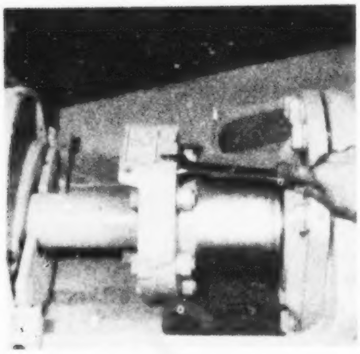
⚠ WARNING

Never visually inspect relief valve or fill valve to see if grease is escaping. Always observe the track to see if it has loosened.

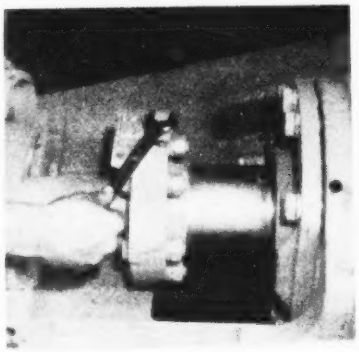
3. Tighten valve when adjustment is correct. Operate tractor back and forth to equalize pressure.

4. Recheck adjustment.

If Track Did Not Loosen:

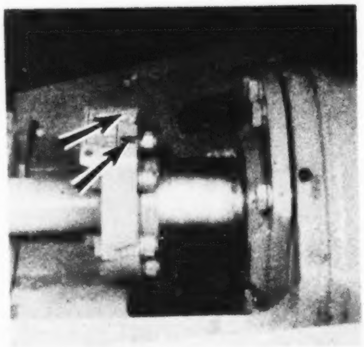


1. Remove guard and loosen fill valve 1 turn. Operate tractor back and forth.



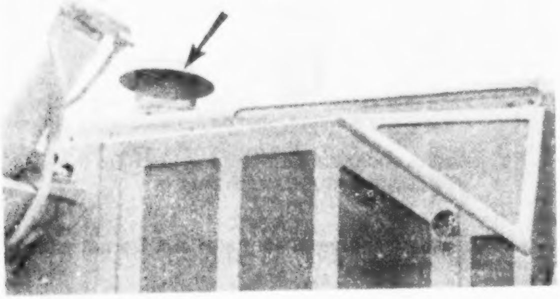
2. Loosen relief valve until it touches guard.

3. Loosen fill valve until it touches guard.



4. Tighten fill and relief valves when adjustment is correct. Contact your Caterpillar dealer if any problems arise.

⑱ PRESCREEN

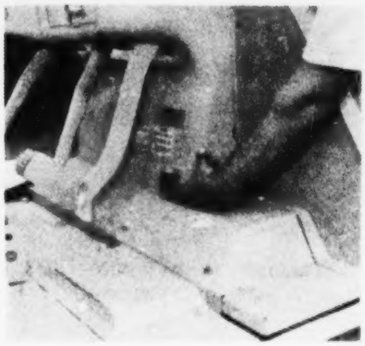


1. Check prescreen for damage and replace if necessary.

2. Wash prescreen in clean solvent, as required, to remove dust and debris on screen.

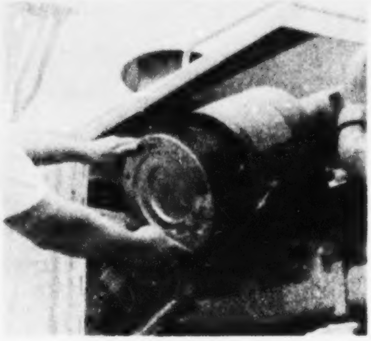
◉ ENGINE AIR INTAKE SYSTEM

⚠ WARNING
Never service air cleaners with engine running.

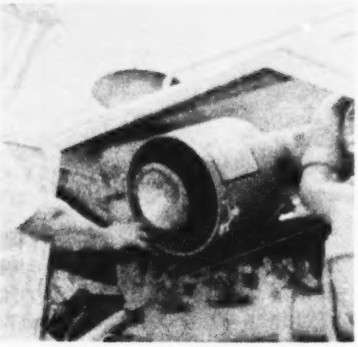


Service filter elements when RED indicator locks in the visible position.

Primary Element



1. Remove cover and primary element.



2. Clean inside of body and cover.

3. Clean and inspect element. (See Page 32).

CAUTION
Always inspect primary element before and after cleaning with a light bulb inside element. Discard if any tears, rips or damage is evident.

4. Install clean element and cover.
5. Reset indicator.

If indicator shows RED shortly after installation of a primary element which has been cleaned approximately 6 times, change to another clean element.

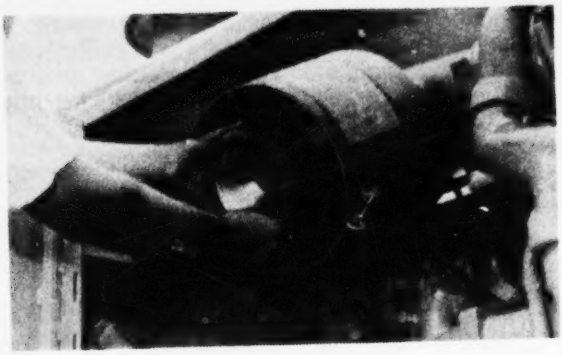
NOTE
The primary element should be replaced after being cleaned a maximum of 6 times. Replace the element once a year even though it has not been cleaned 6 times.

If indicator still shows RED shortly after the installation of the clean primary element, change the secondary element.

Replace the secondary element at the time the primary element is cleaned for the fourth time.

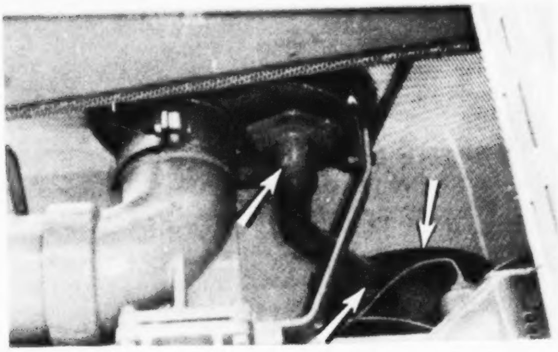
CAUTION
Always replace the secondary element. Do not attempt to reuse by cleaning.

Secondary Element



3. Cover air inlet opening. Clean inside of air cleaner body.

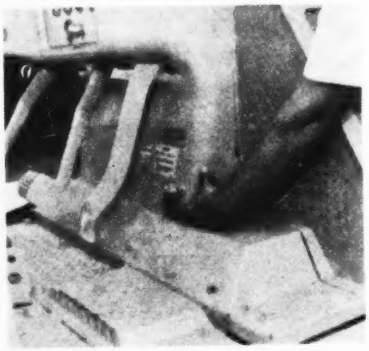
1. Remove cover and primary element.
2. Remove secondary element.



4. Inspect precleaner, dust ejector and exhaust venturi. Clean all parts when necessary.

5. Clean parts with compressed air, a stiff fiber brush or wash in water and non-sudsing detergent. Dry all parts before installation.*

6. Uncover air inlet opening.
7. Install secondary element and retainer. Tighten nuts to 20 ± 5 lb. ft. (2,8 ± 0,7 mkg).
8. Install primary element and cover.



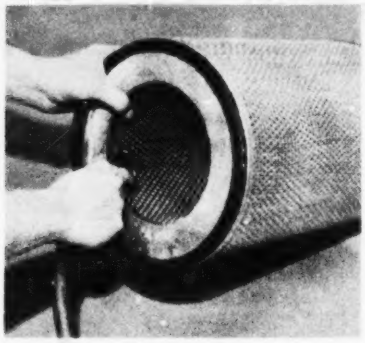
9. Reset filter indicator.

* ⚠ **WARNING**
When using pressure air wear safety glasses and protective clothing. Maximum air pressure must be below 30 PSI (2 kg/cm^2).

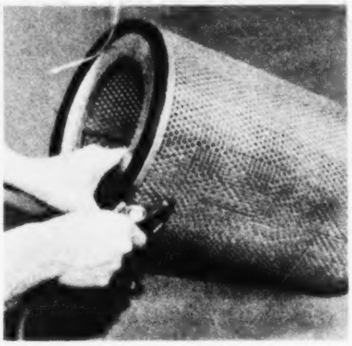
WHEN REQUIRED

CLEANING AIR CLEANER ELEMENTS

Pressure Air — 30 PSI (2 kg/cm^2) Maximum

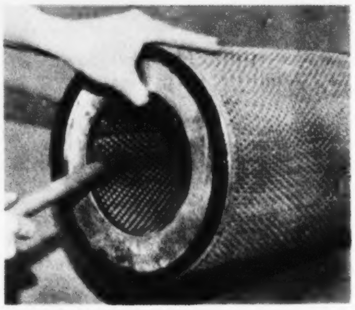


1. Direct air inside element along length of pleats.

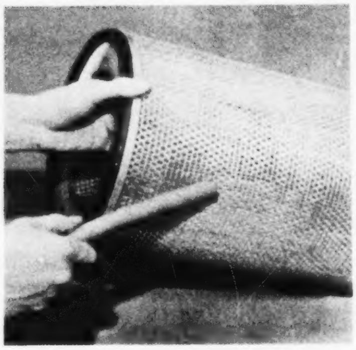


2. Direct air outside along length of pleats. Direct air inside along length of pleats. Check element.

Water — 40 PSI (3 kg/cm^2) Maximum

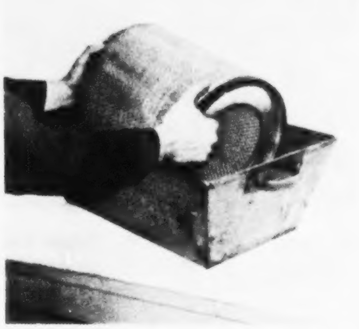


1. Direct water inside element along length of pleats.



2. Direct water outside along length of pleats. Rinse, air dry thoroughly and check.

Detergent

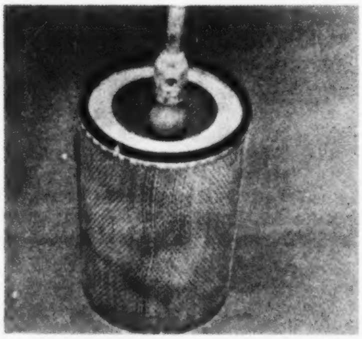


1. Wash in warm water and non-sudsing household detergent.

2. Rinse with clean water, 40 PSI maximum (3 kg/cm^2), see above.

3. Air dry thoroughly and check.

Checking Element



1. Insert light inside clean and dry element and check. Discard element if tears or rips are found.

2. Wrap and store good elements in a clean dry place.

⚠WARNING

When using pressure air for cleaning, wear safety glasses and protective clothing. Maximum pressure should be below 30 PSI (2 kg/cm^2).

CAUTION

Do not clean elements by bumping or tapping.

Do not use elements with damaged pleats, gaskets or seals.

NOTE

Have spare elements on hand to use while cleaning used elements.

㊶ COOLING SYSTEM

Whenever draining and refilling the cooling system, always recheck the coolant level when the engine reaches normal operating temperature.

Remove cap slowly to relieve pressure. Maintain coolant level to within ½ inch (1 cm) of the bottom of the fill pipe.

Use clean water that is low in scale forming minerals — not softened water.

Never add coolant to an overheated engine. Allow it to cool first.

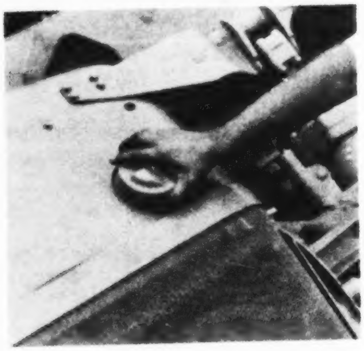
⚠ WARNING
Inhibitor contains alkali, avoid contact with skin and eyes.

Add Caterpillar Corrosion Inhibitor. Follow recommendations given on container.

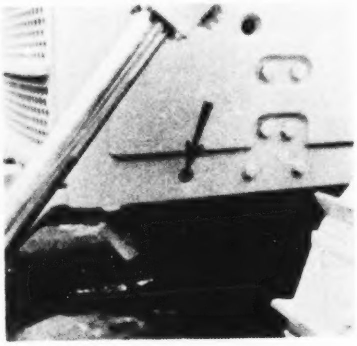
Check specific gravity of antifreeze solution frequently in cold weather to assure adequate protection.

NOTE
If a machine is to be stored, or shipped to an area with below freezing temperatures, refer to Item 32 on page 23.

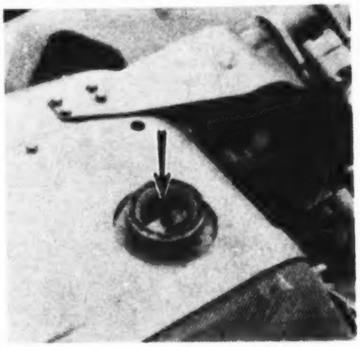
Cleaning Cooling System — Run engine until coolant is warm.



1. Stop engine and loosen filler cap to release pressure. Remove filler cap.



2. Open drain valve and allow system to drain.



3. Close drain valve and fill system with cleaning solution.(1)

4. Start engine and operate for ½ hour.

5. Stop engine and open valve. Flush system with clean water until draining water is clear.

6. Close drain valve and fill system with neutralizing solution.(2)

7. Start engine and operate for 10 minutes.

8. Stop engine, open drain valve and flush system.

9. Close drain valve and add coolant to proper level.

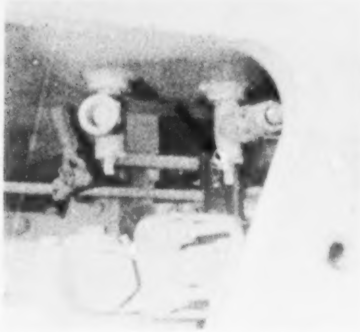
(1) 2 lb. Sodium Bisulphate ($NaHSO_4$) per 10 gal. water (mix 25 grams per 1 liter of water).

(2) ½ lb. Sodium Carbonate Crystals ($Na_2CO_3 \cdot 10\,H_2O$) per 10 gal. water (mix 6 grams per 1 liter of water).

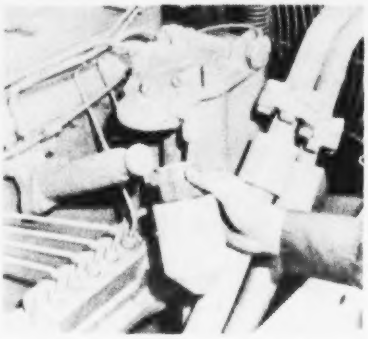
NOTE
Most commercial type cooling system cleaners may be used.

㊷ FUEL SYSTEM

Primary Fuel Filter — Clean Element When Fuel Pressure Gauge Registers OUT With Engine Running.



1. Stop engine and close fuel supply valve.



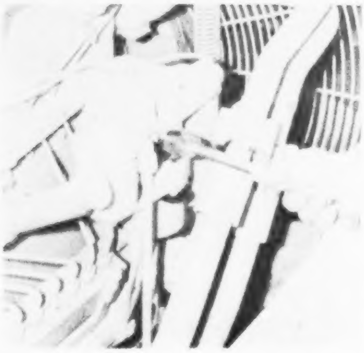
2. Remove case and element. Wash case and element in clean solvent.

3. Install element and case.
4. Open fuel supply valve.
5. Start engine and check for leaks.

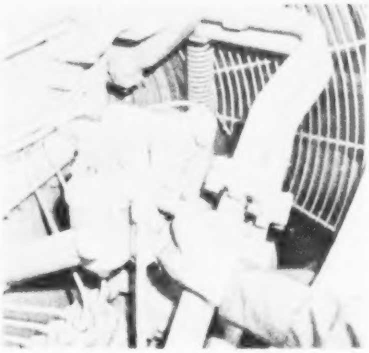
NOTE

Change final fuel filters if fuel pressure gauge still registers OUT with engine running.

Final Fuel Filters



1. Stop engine, close fuel supply valve and remove filters.

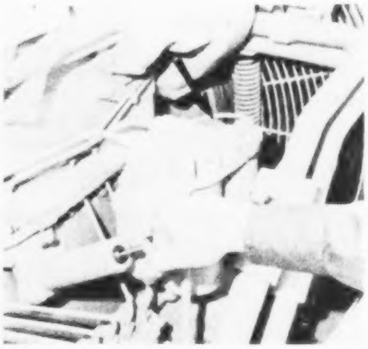


2. Clean filter base. Make sure all of old gasket is removed. Coat gasket of new element with clean diesel fuel.

3. Install new filters. Tighten filters until gasket surfaces contact base, then tighten an additional ½ to ¾ turn.
4. Open fuel supply valve and prime fuel system (see below).
5. Start engine and check for leaks.

Priming Fuel System

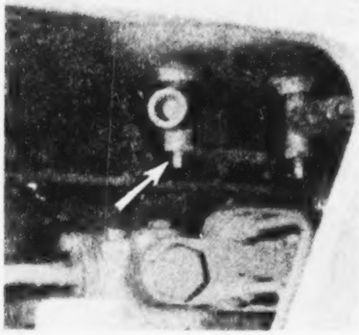
1. Open bleed valve.



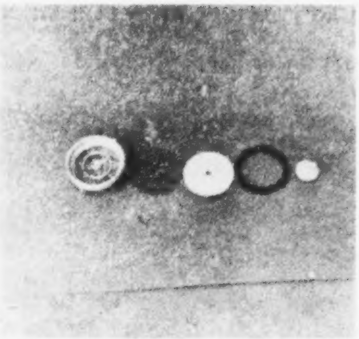
2. Unlock priming pump plunger and operate pump until flow of fuel from drain line contains no air bubbles.

3. Close bleed valve.
4. Start engine and check for leaks.

㊸ DIESEL FUEL TANK AND FILLER CAP

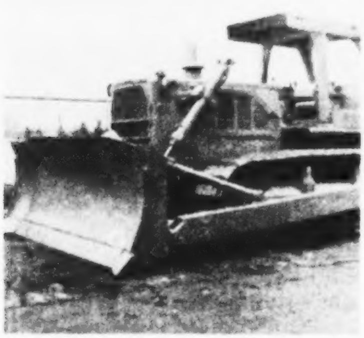


Open drain valve and drain off any sediment or water that may have accumulated.

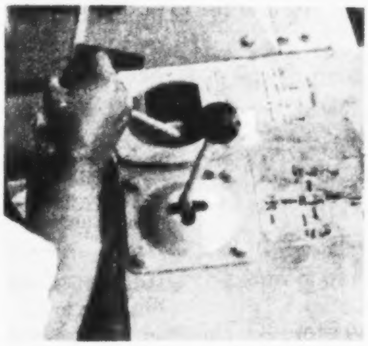


1. Remove and disassemble cap.
2. Wash cap in clean solvent.
3. Oil elements lightly. Assemble and install cap.

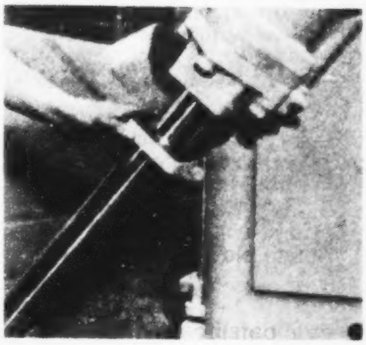
㊹ HYDRAULIC CYLINDERS — Shim adjusted rod packing



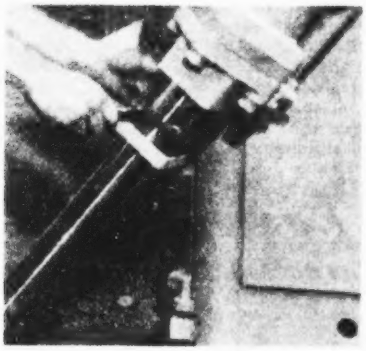
1. Lower blade and stop engine.



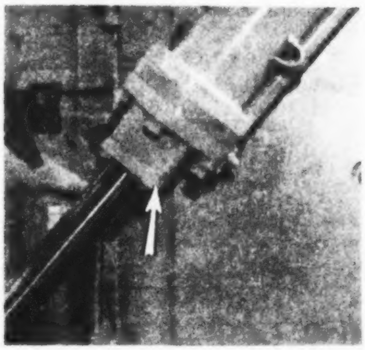
2. Move hydraulic controls to relieve pressure.



3. Remove bolts and slide flange away from cylinder head.



4. Cut and remove 1 shim.

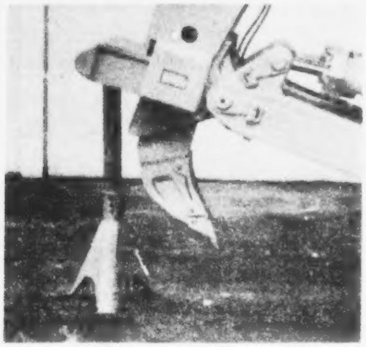


5. Slide flange back and install bolts. Start engine and check for leaks.

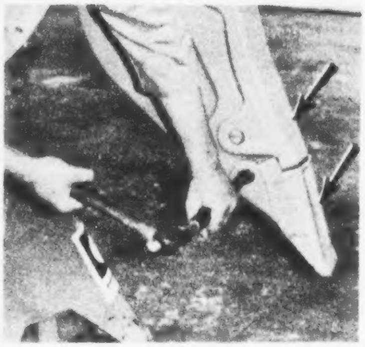
6. If still leaking, remove another shim. Leave at least 2 shims. If packing still leaks, see your Caterpillar dealer.

WHEN REQUIRED

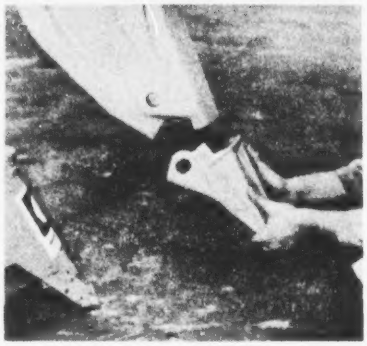
㊺ RIPPER
Protector and Tip



1. Raise and block ripper.

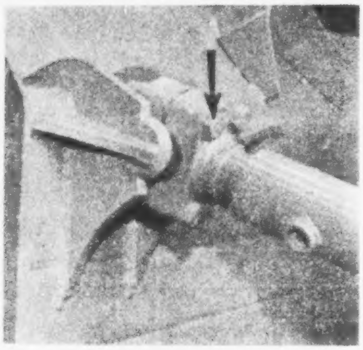


2. Drive pins out, remove protector or tip.
3. Clean pins and shank.



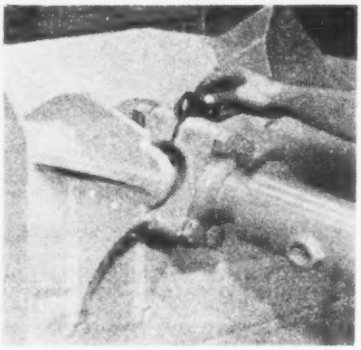
4. Slide new protector or tip on shank and install pins.

㊻ BULLDOZER — Diagonal Arm and Tilt Brace Ball and Socket Adjustment



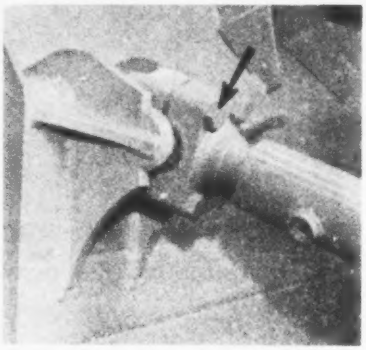
1. Remove cap bolts. Shorten brace and remove shims.

2. Lengthen brace. Install and tighten bolts evenly.



3. Measure clearance between cap and socket with shims.

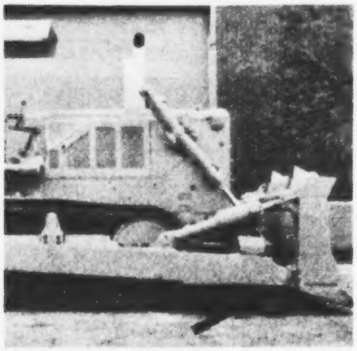
4. Remove bolts and shorten brace. Install shims equal to measured clearance plus 1 shim.



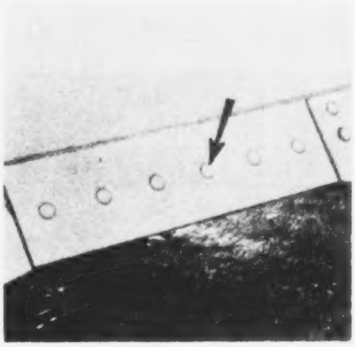
5. Lengthen brace and install bolts.

㊼ CUTTING EDGE AND END BITS

Change cutting edge and use new end bits before wear starts on blade support.

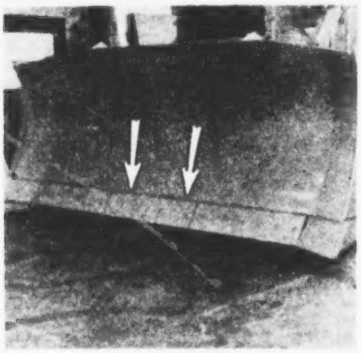


1. Raise and block blade before changing cutting edge or end bits.



2. Remove bolts.

3. Remove cutting edge or bit. Clean contact surfaces.



4. Use opposite cutting edge if not worn. Use new section if both edges are worn.

5. Use new end bits.

6. Install bolts and tighten to specified torque. (See PLOW BOLT TORQUE CHART).

7. After a few hours of operation retighten bolts to proper torque.

Plow Bolt Torque Chart

BOLT TORQUE VALUES FOR GROUND ENGAGING TOOLS

PLOW BOLT SIZE	RECOMMENDED TORQUE*
⅝ in. (16 mm)	195 ± 25 lb. ft. (27 ± 3.4 mkg)
¾ in. (19 mm)	350 ± 50 lb. ft. (48 ± 6.9 mkg)
⅞ in. (22 mm)	565 ± 85 lb. ft. (78 ± 11.7 mkg)
1 in. (25 mm)	900 ± 110 lb. ft. (124 ± 15 mkg)

*These values are applicable only to Caterpillar plow bolts.

REFILL CAPACITIES (Approximate)

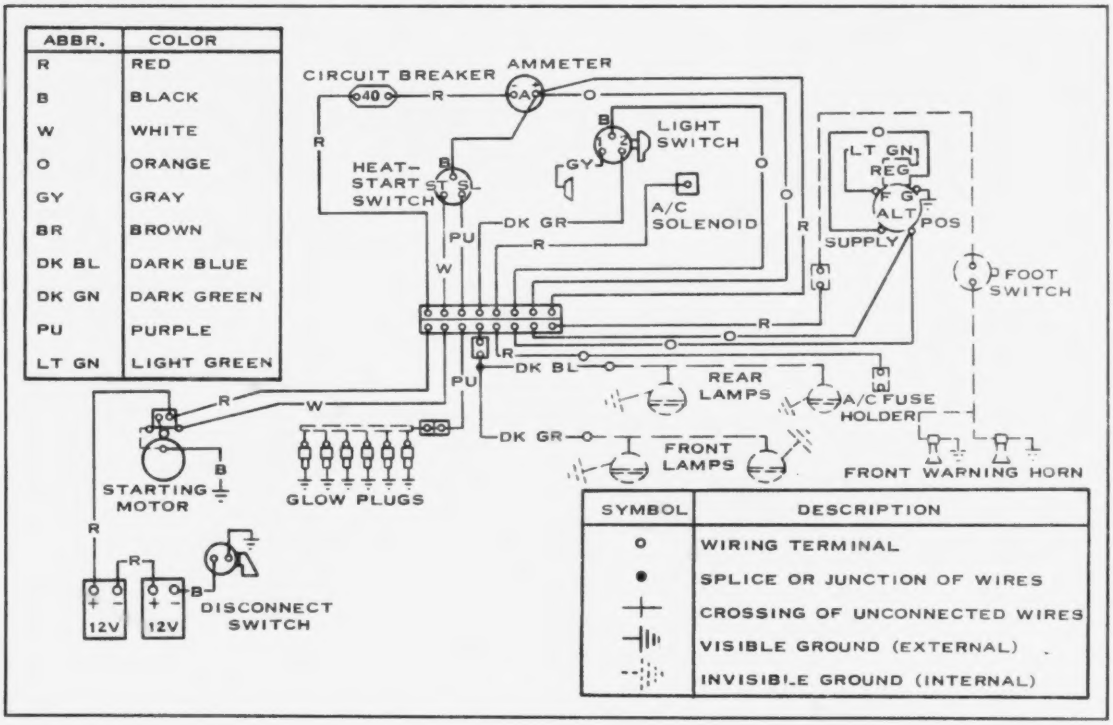
COMPARTMENT OR SYSTEM	U.S. MEASURE	METRIC MEASURE	IMPERIAL MEASURE
Diesel engine crankcase	8.75 gal.	33 ltr.	7.25 gal.
Transmission, bevel gear and steering clutch compartment(1)	31 gal.	117 ltr.	25.75 gal.
Final drives (each)	9.50 gal.	36 ltr.	8 gal.
Cable control gear case	3.75 gal.	14 ltr.	3.25 gal.
Hydraulic system	35 gal.	132,5 ltr.	29.2 gal.
Cooling system	32 gal.	121,2 ltr.	26.7 gal.
Diesel fuel tank	170 gal.	643,5 ltr.	141.6 gal.
Winch oil sump(2)	17 gal.	64,3 ltr.	14.2 gal.

BATTERIES (ELECTROLYTE) 15.2 QTS/BATT.

(1)Quantity of oil in transmission may be increased by 10% when operating on severe slopes.
(2)Use same type of oil as used in engine.

WIRING DIAGRAM

24 VOLT SYSTEM WITH ALTERNATOR

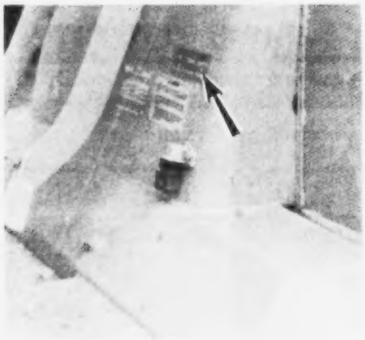

CIRCUIT BREAKER
40
AMMETER
A
R
O
LIGHT SWITCH
B
GY
HEAT-START SWITCH
ST
S
PU
W
DK GR
A/C SOLENOID
LT GN
REG
F G
ALT
POS
SUPPLY
FOOT SWITCH
DK BL
REAR LAMPS
A/C FUSE HOLDER
FRONT LAMPS
FRONT WARNING HORN
STARTING MOTOR
GLOW PLUGS
12V
12V
+ -
DISCONNECT SWITCH

ABBR.	COLOR
R	RED
B	BLACK
W	WHITE
O	ORANGE
GY	GRAY
BR	BROWN
DK BL	DARK BLUE
DK GN	DARK GREEN
PU	PURPLE
LT GN	LIGHT GREEN

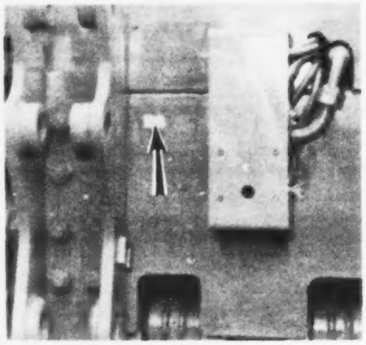
SYMBOL	DESCRIPTION
○	WIRING TERMINAL
●	SPLICE OR JUNCTION OF WIRES
┼	CROSSING OF UNCONNECTED WIRES
⏚	VISIBLE GROUND (EXTERNAL)
⏚	INVISIBLE GROUND (INTERNAL)

SERIAL NUMBER LOCATIONS

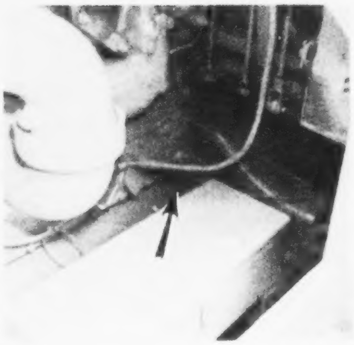
TRACTOR



DASH

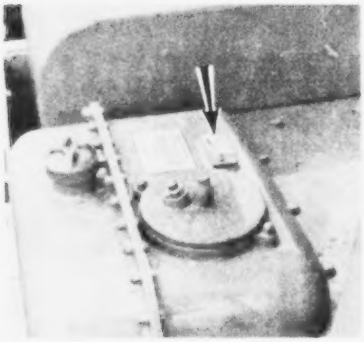


BEVEL GEAR CASE

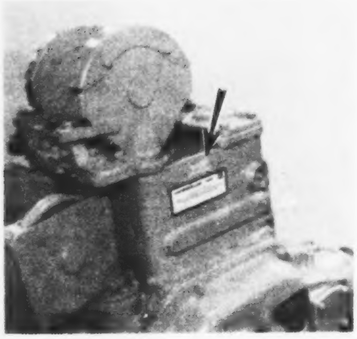


ENGINE

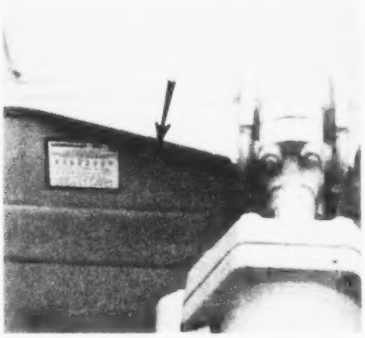
ATTACHMENTS



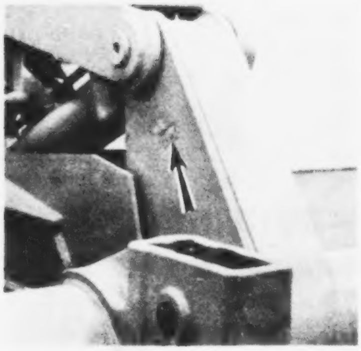
HYDRAULIC CONTROL



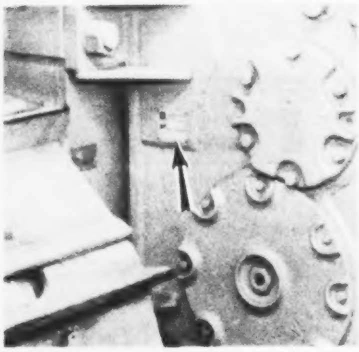
CABLE CONTROL



BULLDOZER



RIPPER



WINCH

SEBU5201

LUBRICATION & MAINTENANCE GUIDE

D8K TRACTOR

DIRECT DRIVE

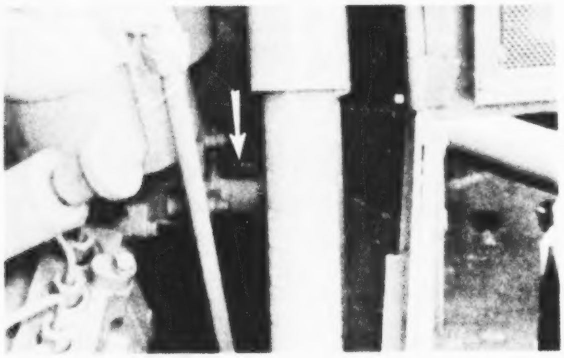
SERIAL NUMBERS | **76V-UP**

FOREWORD

This book is a guide to equipment care. The illustrated, step-by-step instructions are grouped by servicing intervals; items without specific intervals are listed under "When Required". Circled numbers in the Lubrication and Maintenance Chart are to key the charted items to the instructions in the book.

Use the service meter to determine servicing intervals. Calendar intervals (daily, weekly, 2 weeks, etc.) shown may be used instead of service meter intervals if it provides more convenient servicing schedules; and approximates the indicated service meter reading.

Perform previous interval items at multiples of the original requirement. For example, at 100 service hours or 2 weeks, also perform those items listed under "Every 50 Service Hours or Weekly" and "Every 10 Service Hours or Daily".



Service Meter

Some photographs in this publication may show details or attachments that may be different from your unit. Also, the ROPS, for some photographs, has been removed for illustrative purposes.

Continuing improvement and advancement of product design may cause changes to your machine which may not be included in this publication. Each publication is reviewed and revised, as required, to update and include these changes in later editions.

Whenever a question arises regarding your Caterpillar product, or this publication, please consult your Caterpillar dealer for the latest available information.

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Lubrication and Maintenance Chart 7
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Every 100 Service Hours or 2 Weeks 11
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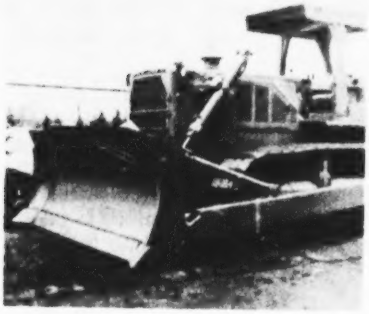
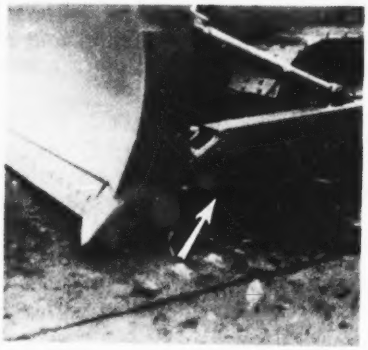
Every 1000 Service Hours or 6 Months 17
Every 2000 Service Hours or 1 Year 20
When Required 25
Wiring Diagram 41
Refill Capacities 42
Serial Number Locations 43

SAFETY

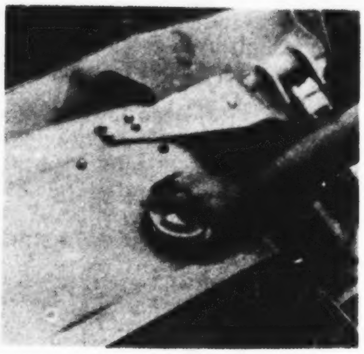
⚠ THIS SYMBOL WARNS OF POSSIBLE PERSONAL INJURY OR PROPERTY DAMAGE.



Lower all equipment before servicing hydraulic system.



Block blade before changing cutting edge or end bits.



Use caution when removing radiator cap, drain plugs, grease fittings or pressure taps.

⚠ WARNING

To avoid possible weakening of the ROPS (Rollover Protection structure), consult a Caterpillar dealer before altering the ROPS in any way. The protection offered by the ROPS will be impaired if it has been subjected to structural damage or has been involved in an overturn incident.

Do not attempt adjustments while tractor is moving or the engine running.

Wear gloves when handling cable.

Use the proper tools. Replace or repair broken or damaged equipment.

Wear safety glasses and shoes as the job requires.

Do not attempt repairs you do not understand.

⚠ WARNING

When using pressure air wear safety glasses and protective clothing. Maximum air pressure must be below 30 PSI (2 kg/cm²).

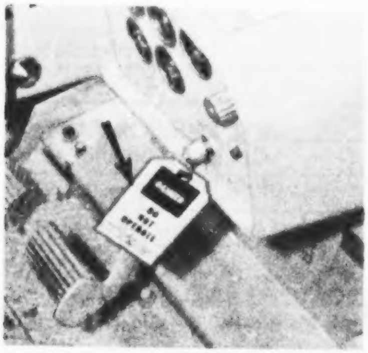
Store oily rags or other combustible material in a safe place.

Operate engine only in well ventilated area.

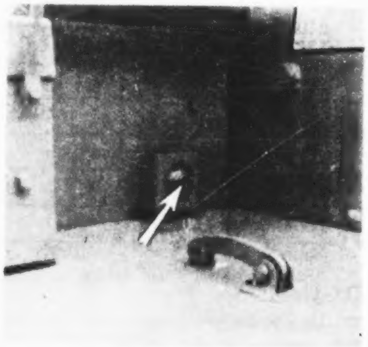
Promote good housekeeping. Keep tools and work area clean.

Do not allow unauthorized personnel on tractor when it is being serviced.

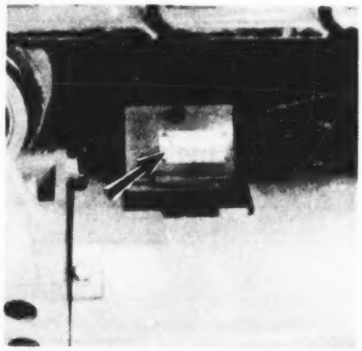
Do not smoke while refueling.



Attach warning tags to controls while tractor is being serviced.



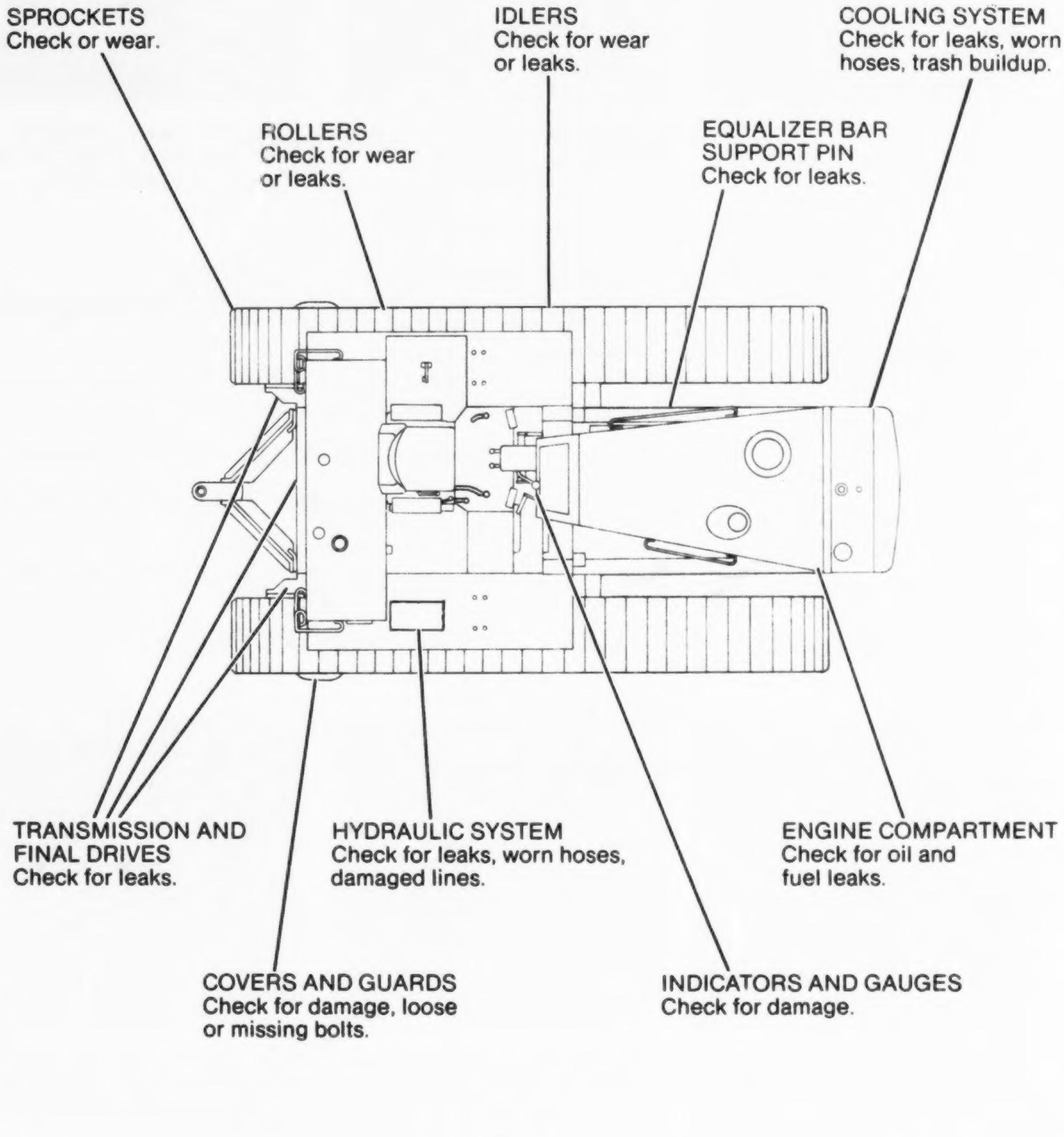
Turn disconnect switch OFF and remove key before servicing electrical system.



Read warning and caution information provided on the tractor. Follow servicing instructions carefully.

WALK-AROUND CHECKS

For maintenance and operator personnel safety, and maximum service life of the machine, make a thorough walk-around inspection when doing lubrication and maintenance work. Check under and around for such items as loose bolts, trash build-up, oil or coolant leaks.


SPROCKETS
Check or wear.
IDLERS
Check for wear
or leaks.
COOLING SYSTEM
Check for leaks, worn
hoses, trash buildup.
ROLLERS
Check for wear
or leaks.
EQUALIZER BAR
SUPPORT PIN
Check for leaks.
TRANSMISSION AND
FINAL DRIVES
Check for leaks.
HYDRAULIC SYSTEM
Check for leaks, worn hoses,
damaged lines.
ENGINE COMPARTMENT
Check for oil and
fuel leaks.
COVERS AND GUARDS
Check for damage, loose
or missing bolts.
INDICATORS AND GAUGES
Check for damage.

FUEL AND LUBRICANT SPECIFICATIONS

NOTE

The abbreviations listed below follow S.A.E. J754 nomenclature. The classifications follow S.A.E. J183 classifications. The MIL specifications are U.S.A. Military Specifications. These definitions will be of assistance in purchasing. The specific classifications for this engine are found on the "RECOMMENDED LUBRICANTS" chart.

Diesel Fuel

Use only distillate fuels (ASTM No. 1 or No. 2 Fuel Oil or No. 1D or No. 2D Diesel Fuel Oil) with a minimum cetane number of 35. Heavier oil is generally preferable because of its higher energy content. Contact your Caterpillar dealer regarding fuels marketed in your area.

Engine Oils (EO)

CD - Use oils that meet Engine Service Classification **CD** or MIL-L-2104C.

CC - Use oils that meet Engine Service Classification **CC**, MIL-L-2104B or MIL-L-46152.

EO - **CD** or **CC**.

Lubricating Grease (MPGM)

Use Multipurpose-type Grease (**MPGM**) which contains 3-5% molybdenum disulfide conforming to MIL-M-7866, and containing a suitable corrosion inhibitor. NLGI No. 2 Grade is suitable for most temperatures. Use NLGI No. 0 or No. 1 Grade for extremely low temperatures.

Hydraulic Oil (HYDO)

Use (**EO**) or industrial-type hydraulic oils (**HYDO**) which are certified by the supplier as having anti-wear, anti-foam, anti-rust and anti-oxidation additive properties for heavy duty use.

Multipurpose-type Gear Lubricant (MPL)

Use Gear Lubricant Classification GL-5, or MIL-L-2105B.

RECOMMENDED LUBRICANTS
AT STARTING TEMPERATURES FROM −10°F (−23°C) TO +120°F (+48°C)(1)

COMPARTMENT OR SYSTEM	STARTING TEMPERATURES	
	ABOVE 32°F (0°C)	BELOW 32°F (0°C)
CD		
Engine Crankcase	SAE 30	SAE 10W(2)
Transmission, Bevel Gear, Flywheel Clutch and Steering Clutches	SAE 30	SAE 10W
Winch Oil Sump	SAE 30	SAE 10W
Cable Control Gear Case	SAE 30	SAE 10W
Track Rollers and Idlers	SAE 30	SAE 30
HYDO		
Hydraulic System	SAE 10W	SAE 10W
EO		
Final Drives	SAE 50	SAE 30
MPL		
Equalizer Bar Support Pin	SAE 90	SAE 90
Sealed and Lubricated Track	SAE 90	SAE 90

(1) Below −10°F (−23°C) consult your Caterpillar dealer for Cold Weather Recommendations.

(2) SAE 10W oil may be used in the diesel engine even if daytime ambient temperature rises to 70°F (21°C). Below −10°F (−23°C) it may be necessary to warm the engine oil so the engine can be cranked and the oil will circulate freely.

Key to Lubricants:

CD - Engine Service Classification **CD**, or MIL-L-2104C
CC - Use oils that meet Engine Service Classification **CC**, MIL-L-2104B or MIL-L-46152
EO - **CD** or **CC**
MPL - GL-5 or MIL-L-2105B
HYDO - **EO**, or certified Industrial-type Hydraulic Oils
MPGM - Multipurpose-type Grease with 3 to 5% Molybdenum Disulfide.

General Service Recommendations

NOTE

The engine cooling system is protected to −20°F (−29°C), with permanent-type antifreeze, when shipped from the factory.

Fill fuel tank at the end of each day of operation to drive out moisture laden air and prevent condensation.

Check fuel level with dipstick in filler opening.

Use clean water that is low in scale forming minerals, not softened water.

Add Caterpillar Corrosion Inhibitor to coolant. Follow recommendation given on container.

LUBRICATION AND MAINTENANCE CHART

ITEM	SERVICE	LUBRICANT	MAINTENANCE	PAGE NO.
EVERY 10 SERVICE HOURS OR DAILY				
① Engine crankcase	Check lubricant level	CD		10
② Radiator	Check coolant level		●	10
EVERY 50 SERVICE HOURS OR WEEKLY				
③ Ripper link and cylinder bearings	Lubricate 12 fittings	MPGM		10
EVERY 100 SERVICE HOURS OR 2 WEEKS				
④ Cable control sheave bearings	Lubricate 6 fittings	MPGM		11
⑤ Hydraulic control system(4)	Check oil level	HYDO		11
⑥ Batteries	Check electrolyte level		●	11
EVERY 250 SERVICE HOURS OR MONTHLY				
⑦ Engine crankcase	Change lubricant(1) and filter elements, wash breather	CD	●	12
⑧ Transmission, bevel gear, flywheel clutch and steering clutch compartments	Change filter element and wash magnetic strainer	CD	●	12
⑨ Track roller frame inner bearings	Lubricate 2 fittings	MPGM		13
⑩ Fan and adjusting pulley bearings	Lubricate 2 fittings	MPGM		13
⑪ Flywheel clutch brake lever and bellcrank	Lubricate 2 fittings	MPGM		14
⑫ Bulldozer cylinder support and upper trunnion bearings	Lubricate 6 fittings	MPGM		14
⑬ Bulldozer tilt brace	Lubricate 2 fittings	MPGM		14
⑭ Cable control shroud bearings	Lubricate 6 fittings	MPGM		14
⑮ Cable control clutch lever rollers	Lubricate 2 fittings	MPGM		14
⑯ Cable control lever shaft and brake lever bearings	Lubricate 4 fittings	MPGM		15
⑰ Parking brake lever	Check to see if it engages		●	15
⑱ Steering clutch brakes	Check — adjust if necessary		●	15
⑲ Fan and alternator belts	Check — adjust if necessary		●	16
EVERY 500 SERVICE HOURS OR 3 MONTHS				
⑳ Hydraulic control system(3)	Change filter elements	HYDO	●	16
㉑ Winch filter	Change filter		●	17
㉒ Winch magnetic strainer	Wash magnetic strainer		●	17

LUBRICATION AND MAINTENANCE CHART

ITEM	SERVICE	LUBRICANT	MAINTENANCE	PAGE NO.
EVERY 1000 SERVICE HOURS OR 6 MONTHS				
㉓ Transmission, bevel gear, flywheel clutch and steering clutch compartments(2)	Change lubricant and plastic breathers	CD	●	17
㉔ Final drives	Change lubricant — filter elements — breathers	EO		18
㉕ Winch oil sump	Change lubricant	CD		18
㉖ Cable control	Wash breather		●	19
㉗ Winch breather	Change plastic breather		●	19
㉘ Universal joints	Lubricate 2 fittings	MPGM		19
㉙ Flywheel clutch cross shaft bearings	Lubricate 2 fittings	MPGM		19
㉚ Cable control fairlead sheave	Lubricate 2 fittings	MPGM		19
EVERY 2000 SERVICE HOURS OR 1 YEAR				
㉛ Hydraulic control system	Change oil — wash filler screen	HYDO	●	20
㉜ Cable control gear case	Change lubricant	CD		20
㉝ Cooling system	Renew coolant antifreeze		●	21
㉞ Engine valve lash	Check — adjust if necessary		●	22
WHEN REQUIRED				
㉟ Transmission, bevel gear, flywheel clutch and steering clutch compartment	Check lubricant level if leakage develops or is suspected	CD		25
㊱ Final drives	Check lubricant level if leakage develops or is suspected	EO		25
㊲ Cable control	Check lubricant level if leakage develops or is suspected, adjust brake and clutch if necessary and check condition of cable	CD		25
㊳ Winch	Check lubricant level if leakage develops or is suspected and check condition of cable	CD		28
㊴ Flywheel clutch suction screen	Clean when lubricant becomes thick or at time of repairs on brakes, transmission or flywheel clutch		●	29

LUBRICATION AND MAINTENANCE CHART

ITEM	SERVICE	LUBRICANT	MAINTENANCE	PAGE NO.
WHEN REQUIRED (Cont.)				
㊵ Engine air inlet system	Clean when RED band in indicator locks in visible position		●	30
㊶ Cooling system	Drain and clean when engine overheats or solution is dirty		●	33
㊷ Prescreen	Check — clean if necessary		●	34
㊸ Track	Make adjustment if track sag is not 1½" to 2"		●	34
㊹ Fuel system	Change filter when fuel gauge registers OUT with engine running		●	36
㊺ Fuel tank	Drain moisture and sediment and wash cap whenever engine misfires or frequent fuel filter replacement is required		●	37
㊻ Hydraulic cylinders	Make rod packing adjustment if leakage develops or is suspected		●	37
㊼ Flywheel clutch	Adjust clutch if slippage develops — adjust clutch brake if brake becomes slow in stopping flywheel		●	38
㊽ Bulldozer ball sockets	Make adjustment if brace is too loose		●	39
㊾ Cutting edge and end bits	Change cutting edge and use new end bits, if worn		●	40
㊿ Ripper tips	Change ripper tip if damaged or worn		●	40

(1) Normal oil change interval when fuel sulphur content is 0.4% or less. When sulphur content is 0.4% to 1.0%, reduce oil change interval one-half. When sulphur content is above 1.0%, reduce oil change to one-fourth normal interval.

(2) Change oil anytime it becomes thick and black.

(3) Change elements anytime filter indicator shows RED with engine running and oil is at operating temperature.

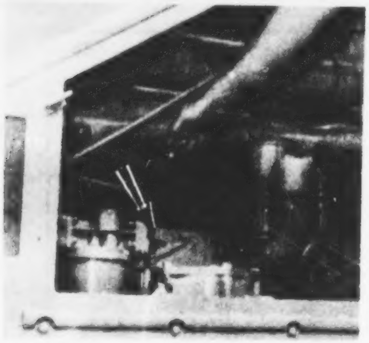
(4) Check frequently if any signs of leakage develop or are suspected.

Key to Lubricants:

CD - Engine Service Classification **CD** or MIL-L-2104C
CC - MIL-L-2104B or MIL-L-46152
EO - **CD, CC**
HYDO - **EO** or certified Industrial-type Hydraulic Oils
MPGM - Multipurpose-type Grease with 3.0% to 5.0% Molybdenum Disulfide
MPL - GL-5, MIL-L-2105B

EVERY 10 SERVICE HOURS OR DAILY

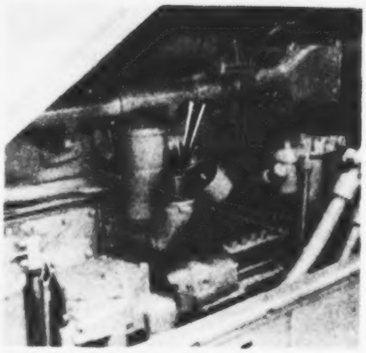
① ENGINE CRANKCASE



1. Check oil level. Machine must be level and brake lock applied. Check can be made . . .

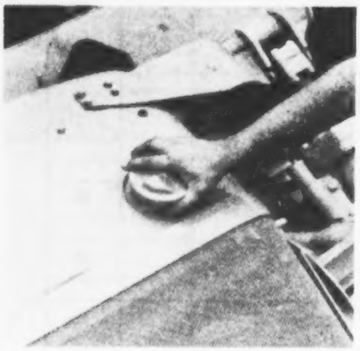
2. . . . before starting. Level must be in SAFE STARTING RANGE on ENGINE STOPPED side of dipstick, or . . .

3. . . . with engine warm and running. Maintain level between ADD and FULL marks on ENGINE RUNNING side of dipstick.

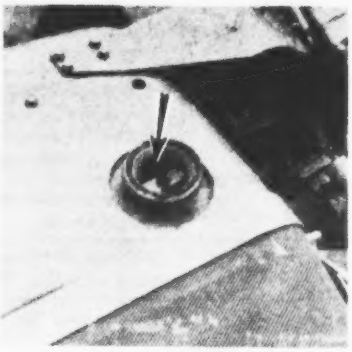


4. Add oil as necessary, through crankcase fill pipe.

② RADIATOR



1. Check coolant level with engine stopped. Remove cap slowly to relieve pressure.

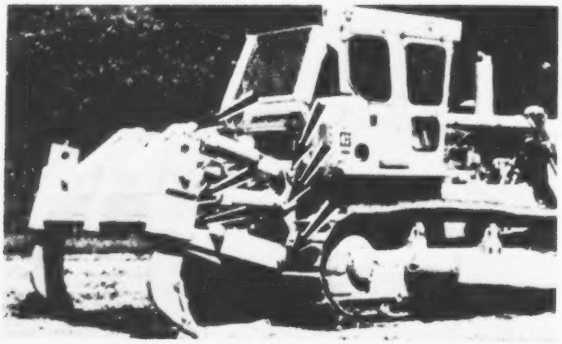


2. Maintain level to within ½ inch (1 cm) of bottom of fill pipe.

3. Use clean water that is low in scale forming minerals, not softened water.

EVERY 50 SERVICE HOURS OR WEEKLY

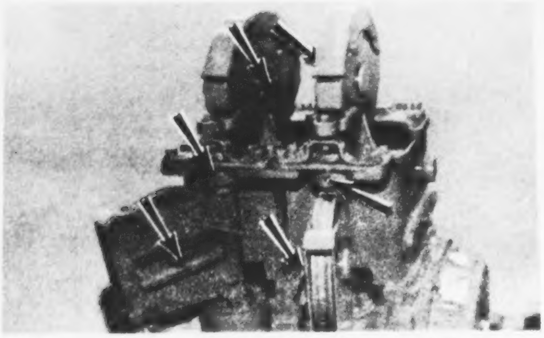
③ RIPPER LINK AND CYLINDER BEARINGS



Lubricate 6 fittings on each side of ripper. Total 12 fittings.

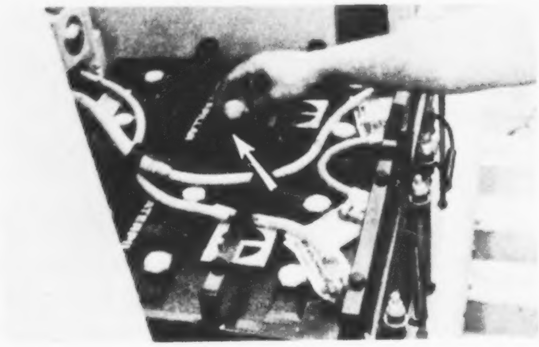
EVERY 100 SERVICE HOURS OR 2 WEEKS

④ CABLE CONTROL SHEAVE BEARINGS



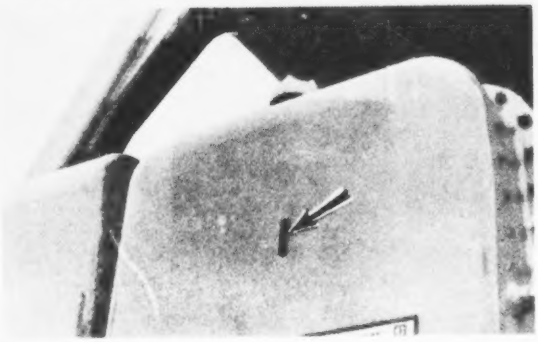
Lubricate 6 fittings.

⑥ BATTERIES



Maintain electrolyte level at triangle in fill plug opening.

⑤ HYDRAULIC CONTROL SYSTEM



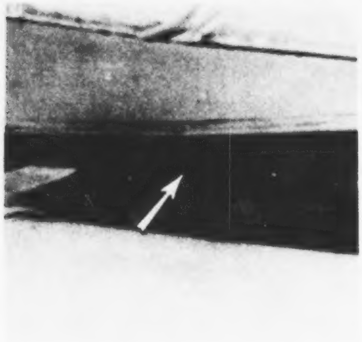
Check oil level with equipment lowered (engine running at low idle, transmission in NEUTRAL, brake lock engaged). Oil should be visible in sight gauge.

NOTE

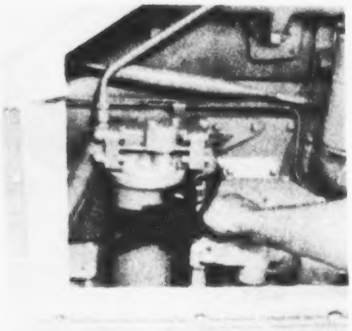
At proper charging rate, batteries will not require more than 1 ounce (30 cc) of water per cell per week. Keep batteries clean.

EVERY 250 SERVICE HOURS OR MONTHLY

⑦ ENGINE CRANKCASE



1. Run engine long enough to warm oil. Park on level ground. Stop engine. Open drain valve and drain oil.



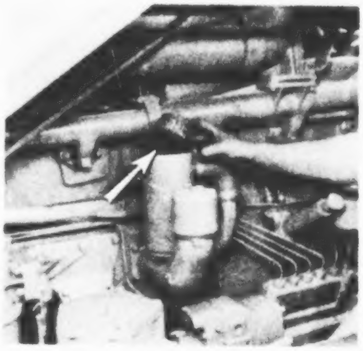
2. Remove old filter.

3. Clean filter base. Make sure all of old gasket is removed.

4. Apply thin film of clean oil to gasket of new filter.

5. Install filter, tighten until gasket contacts base. Tighten filter an additional ¾ turn. Do not overtighten.

6. Close drain valve.



7. Remove breatner. Wash breather in clean solvent.

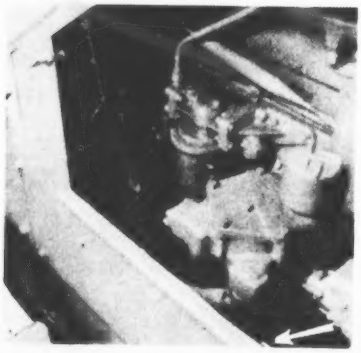
8. Inspect seal, install new seal if necessary. Install breather. Tighten bolt.

9. Fill crankcase. See Refill Capacities.

10. Start engine and run at low idle to fill filter housing. Check oil level. Add oil if necessary.

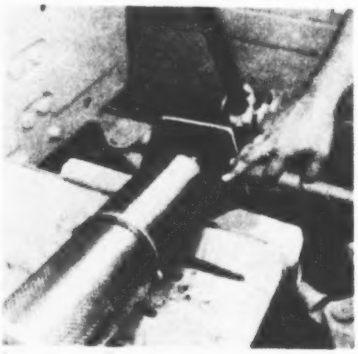
11. Check for leaks.

① TRANSMISSION, BEVEL GEAR, FLYWHEEL CLUTCH AND STEERING CLUTCH COMPARTMENT

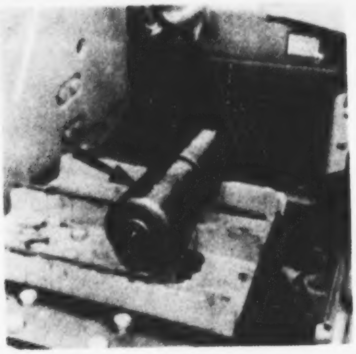


1. Remove filter plug and allow oil to drain.

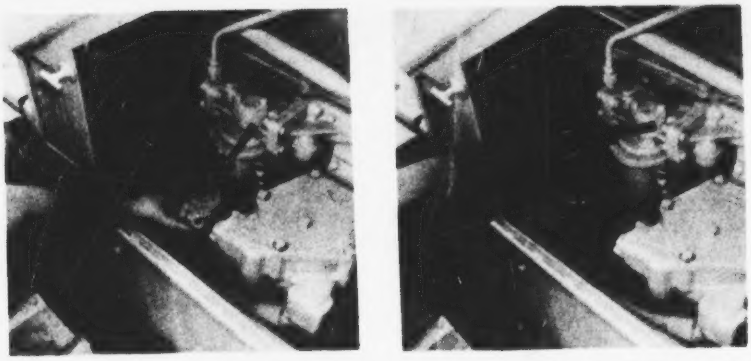
2. Remove cover and old elements.



3. Clean cover and inspect seals Install new seals if necessary.



4. Secure new elements to cover. Install elements, cover and drain plug.



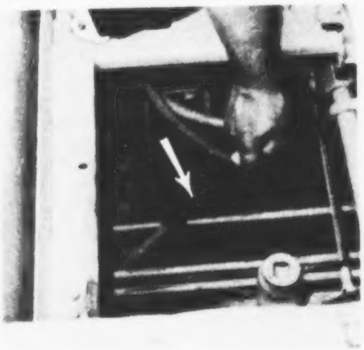
5. Remove cover, spring, screen and magnets from magnetic strainer. Wash screen in clean solvent. Clean magnets with a stiff brush , a clean cloth or pressure air. Do not drop or rap magnets.

⚠ WARNING

When using pressure air wear safety glasses and protective clothing. Maximum air pressure must be below 30 PSI (2 kg/cm^2).

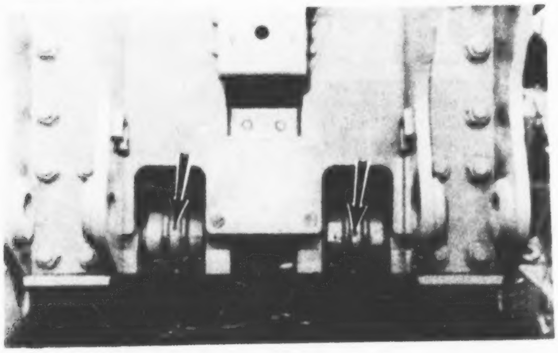
6. Clean cover and check seal. Install new seal if necessary.

7. Install magnets, screen, spring and cover.



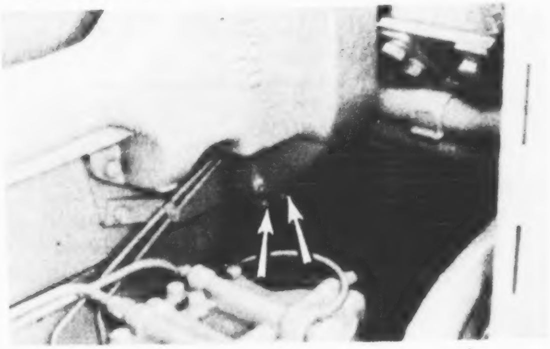
8. Start and run engine at low idle to fill filter. Add oil to bring level to FULL mark on dipstick.

⑨ TRACK ROLLER FRAME INNER BEARINGS



Lubricate 2 fittings.

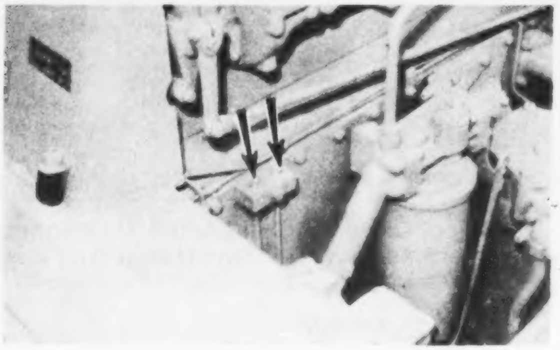
⑩ FAN AND ADJUSTING PULLEY BEARINGS



Lubricate 2 fittings.

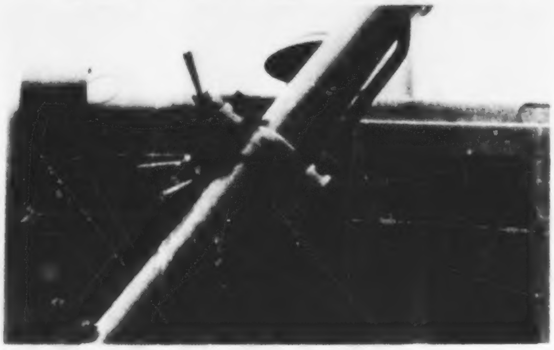
EVERY 250 SERVICE HOURS OR MONTHLY

⑪ FLYWHEEL CLUTCH BRAKE LEVER AND BELLCRANK

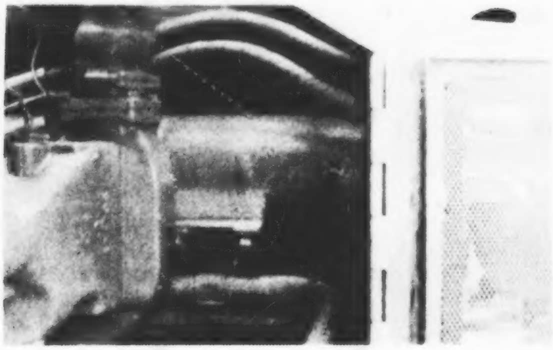


Lubricate 2 fittings.

⑫ BULLDOZER CYLINDER SUPPORT AND UPPER TRUNNION BEARINGS

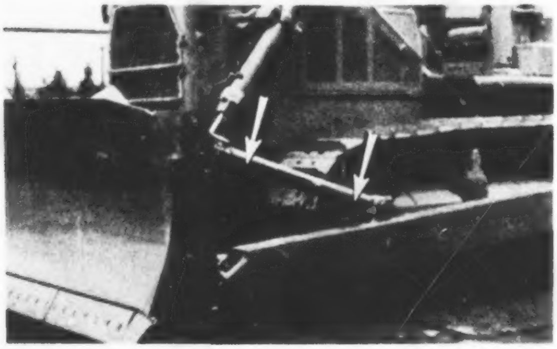


1. Lubricate 2 fittings on each side of tractor. Total 4 fittings.



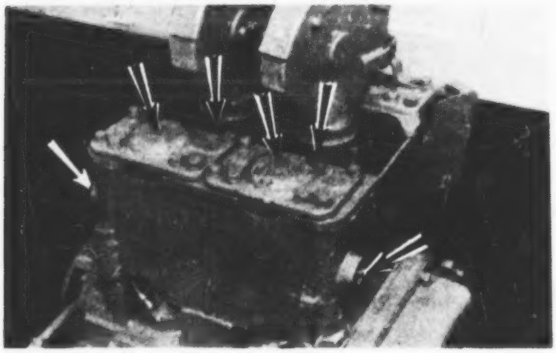
2. Lubricate 1 fitting on each side of tractor, total 2 fittings.

⑬ BULLDOZER TILT BRACE



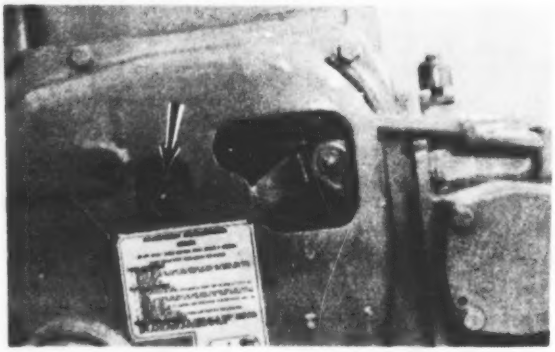
Lubricate 2 fittings.

⑭ CABLE CONTROL SHROUD BEARINGS



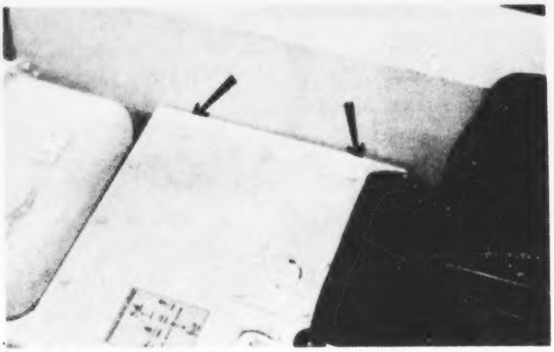
Lubricate 6 fittings.

⑮ CABLE CONTROL CLUTCH LEVER ROLLER

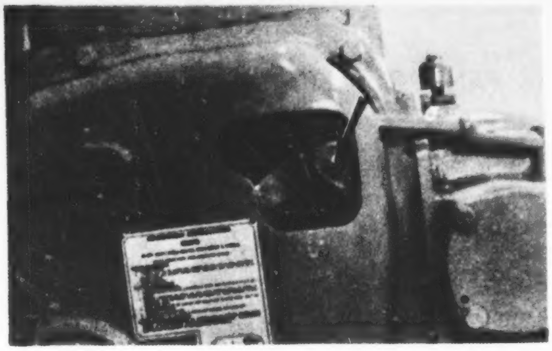


Lubricate 1 fitting on each side of cable control. Total 2 fittings.

⑯ CABLE CONTROL LEVER SHAFT AND BRAKE LEVER BEARINGS

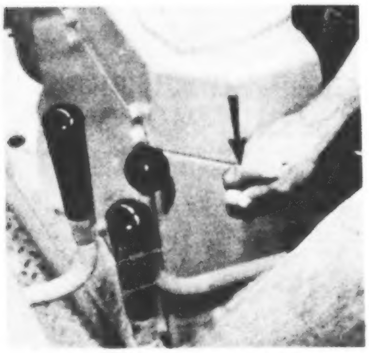


1. Lubricate 2 fittings.



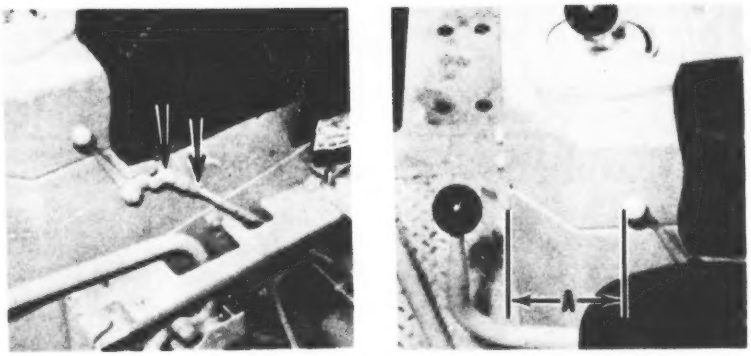
2. Lubricate 1 fitting on each side of cable control. Total 2 fittings.

⑰ PARKING BRAKE LEVER



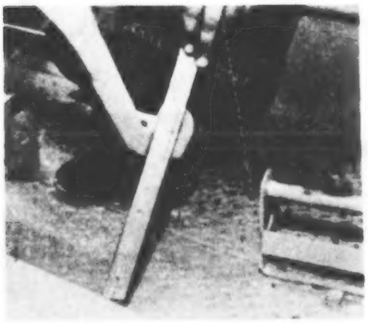
Check to see that parking brake lever engages properly. If it does not, adjust lever linkage.

To Adjust:



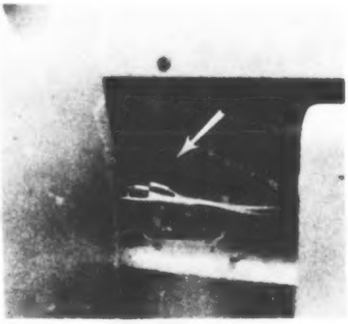
Disengage brake lever. Disconnect lever. Loosen nut and adjust length of rod so that dimension "A" is 4 inches (101,6 mm). Tighten nut and connect lever. If tractor is not equipped with a console,lever should be 3.5 inches (88,9 mm) from front edge of seat frame.

⑱ STEERING CLUTCH BRAKES

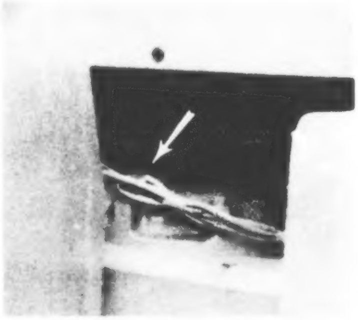


Checkadjustment. Adjust brakes when pedal travel reaches 6 to 6½ inches (150 to 165 mm).

To Adjust:



1. Remove guard and cover.

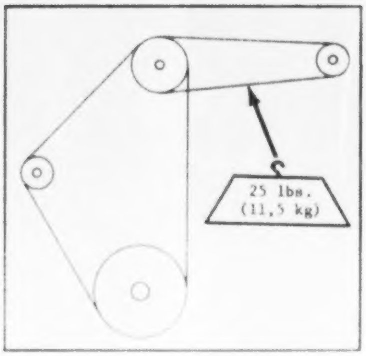


2. Turn adjusting screw in until tight (brake band tight against brake drum). Back screw out 1½ turns (9 clicks).

EVERY 250 SERVICE HOURS OR MONTHLY

⑩ FAN AND ALTERNATOR BELTS

1. Check condition of belts. Always install a matched set of belts when any belt requires replacement.



2. Check alternator belt. Correct adjustment allows approximately ¾ inch (19 mm) deflection.

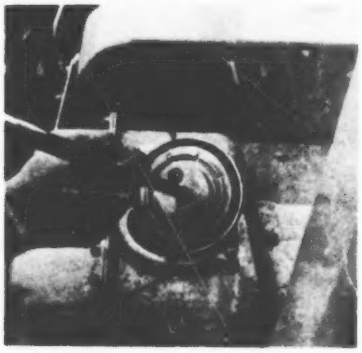
To adjust alternator belt: Loosen mounting bolts and move alternator to obtain correct adjustment. Tighten mounting bolts.

EVERY 500 SERVICE HOURS OR 3 MONTHS

⑳ HYDRAULIC CONTROL SYSTEM

1. Lower all equipment and stop engine.

2. Remove cover and old element.



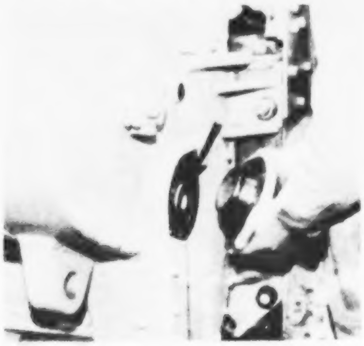
3. Check cover seal. Install new seal if necessary.

4. Install new element. Install cover.

5. Start engine and operate at low idle.

6. Check oil level. Oil should be visible in sight gauge. Add oil as required.

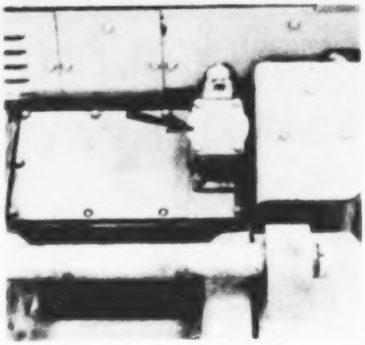
㉑ WINCH FILTER



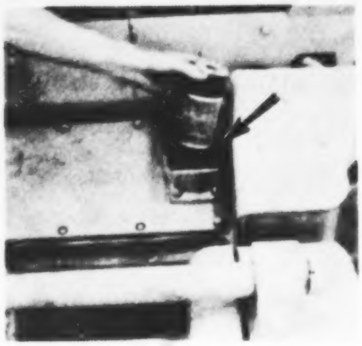
1. Remove cover and filter element. Install new element.

2. Inspect seal. Install a new seal if necessary. Install cover.

㉒ WINCH MAGNETIC STRAINER



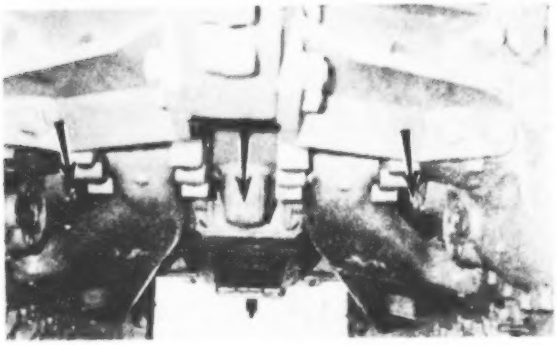
1. Remove cover and strainer. Wash strainer in clean solvent.



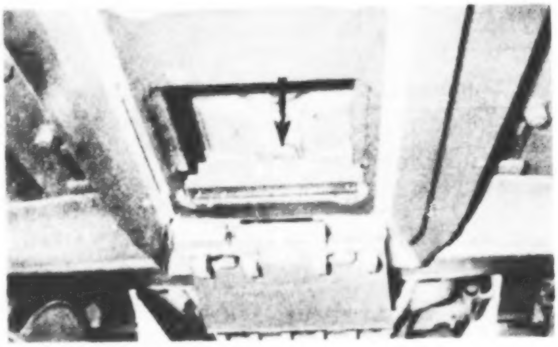
2. Install strainer. Inspect seal. Install a new seal if necessary. Install cover.

EVERY 1000 SERVICE HOURS OR 6 MONTHS

㉓ TRANSMISSION, BEVEL GEAR, FLYWHEEL CLUTCH AND STEERING CLUTCH COMPARTMENT



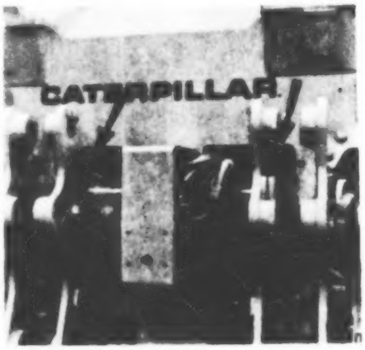
1. Oil should be warm before draining. Remove bevel gear and steering clutch drain plugs.



2. Remove flywheel clutch housing drain plug.

3. Change filter elements. Wash magnetic strainers. See Item ①.

4. Install all drain plugs.



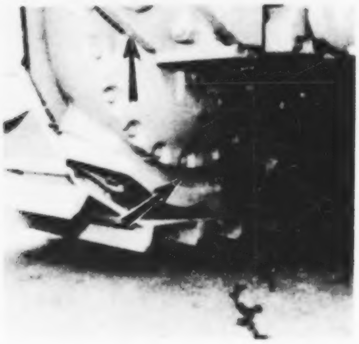
5. Remove 2 breathers and install new ones.

6. Fill compartment. See REFILL CAPACITIES. Start engine and check oil level. Oil should be up to FULL mark on dipstick.

7. Install fill cap.

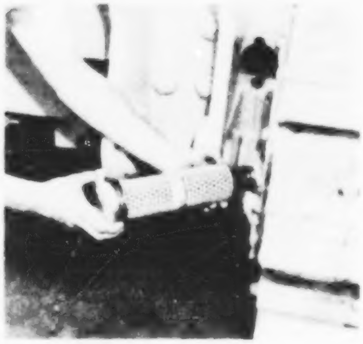
EVERY [illegible] SERVICE HOURS OR 6 MONTHS

㉔ FINAL DRIVES



1. Remove fill and drain plugs (one each side) and allow oil to drain.

2. Remove covers and filter elements.



3. Remove old elements from covers and install new elements on covers.

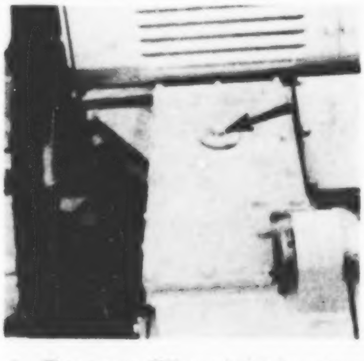
4. Check seal. Use new one if necessary.

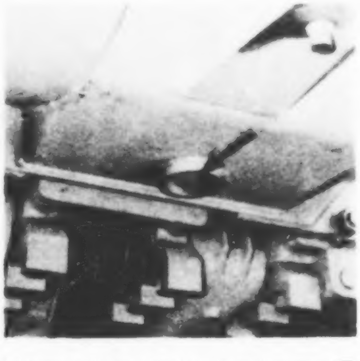
5. Install new filter elements and covers.

6. Install drain plugs and fill compartment. See Refill Capacities. Install fill plugs.

7. Remove and discard breather. Install new breather.

㉕ WINCH OIL SUMP

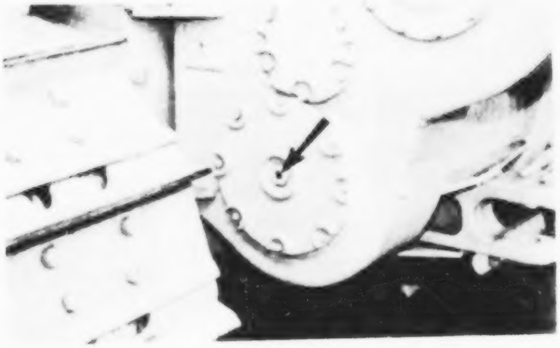




1. Remove fill and drain plugs. Allow oil to drain. Do items ㉑ and ㉒.

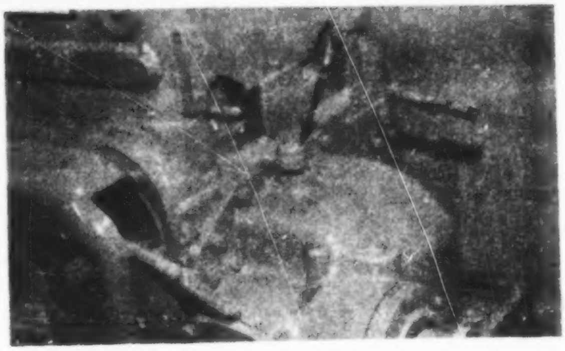
2. Clean and install drain plug.

3. Fill compartment until oil is visible in the sight gauge. See REFILL CAPACITIES. Clean and install fill plug.



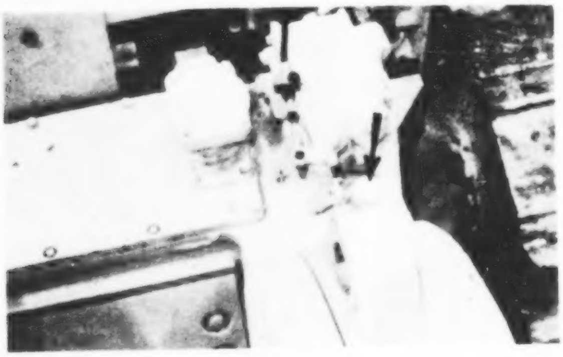
4. Start engine and operate at low idle. Check oil level with engine running at low idle. Oil level must be visible in sight gauge.

㉖ CABLE CONTROL



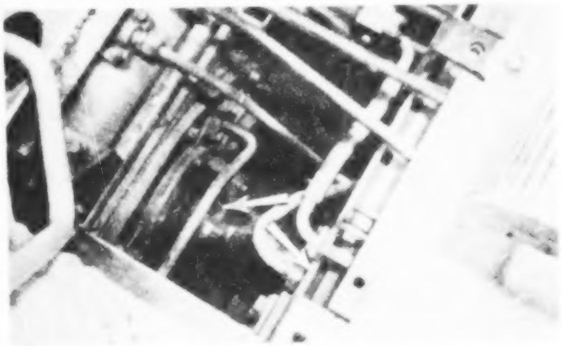
Remove breather. Wash in clean solvent. Lightly oil element and install breather.

㉗ WINCH BREATHER



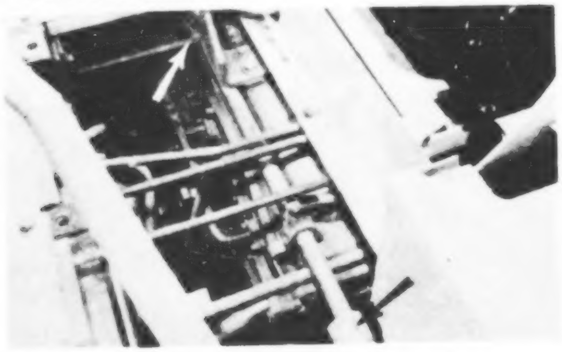
Remove and discard breather. Install a new breather.

㉘ UNIVERSAL JOINT



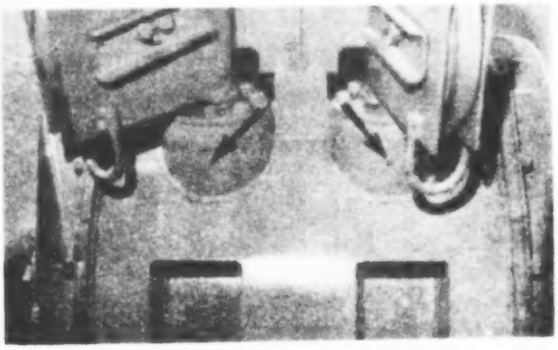
Remove floor plate and lubricate 2 fittings.

㉙ FLYWHEEL CLUTCH CROSS SHAFT BEARINGS



Lubricate 2 fittings.

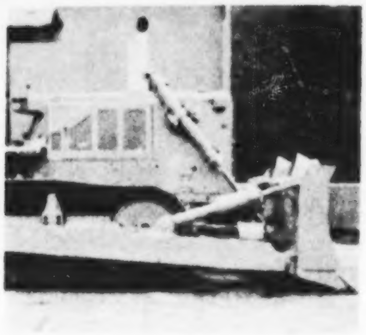
㉚ CABLE CONTROL FAIR-LEAD SHEAVE LOWER BEARINGS



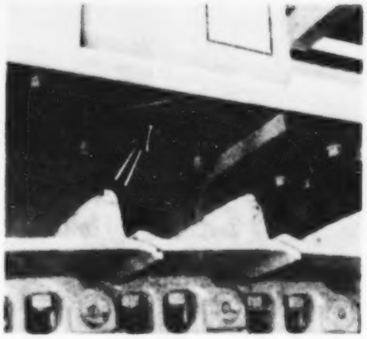
Remove plugs and install 2 fittings. Lubricate 2 fittings, remove fittings and install plugs.

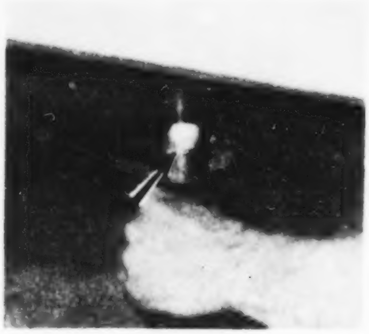
EVERY 2000 SERVICE HOURS OR 1 YEAR

㉛ HYDRAULIC CONTROL SYSTEM



1. Position tractor on level ground. Lower all equipment.



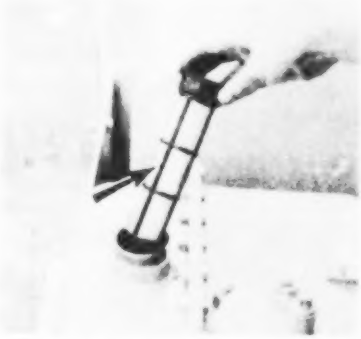


2. Stop engine and remove fill plug. Remove plate under fender and remove drain plug. (Insert a 1 inch (25,4 mm) pipe nipple, approximately 6 inches (152 mm) long, into drain to relieve check valve. Allow oil to drain.

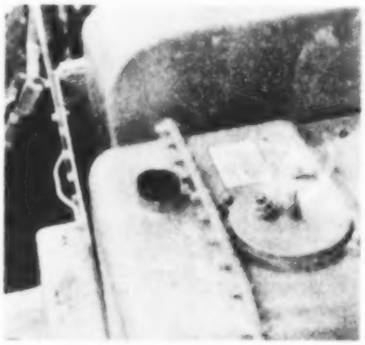
⚠ WARNING
Extreme caution should be used, oil can be hot and may cause personal injury.

3. Remove pipe nipple and install drain plug and plate.

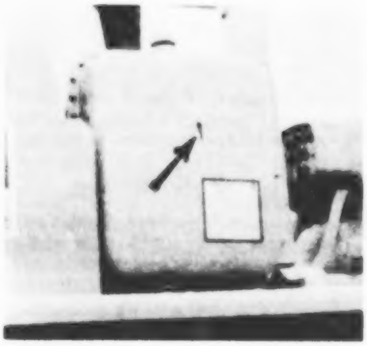
4. Change filter element. See Item ㉘.



5. Remove filler strainer. Wash strainer in clean solvent. Install strainer.



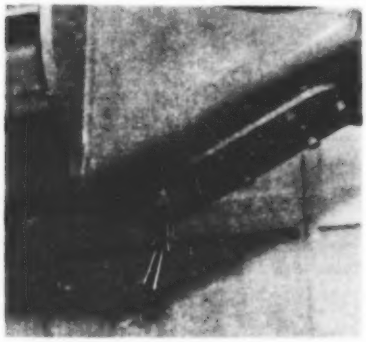
6. Add oil to tank until it is visible in sight gauge. See REFILL CAPACITIES.



7. Check oil level.

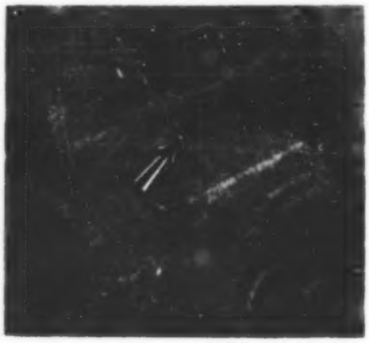
8. Clean and install filler cap.

㉜ CABLE CONTROL GEAR CASE



1. Remove fill and drain plugs. Allow oil to drain.

2. Clean and install drain plug.



3. Fill gear case with oil to level of fill plug opening. Install fill plug. See REFILL CAPACITIES.

⑶ COOLING SYSTEM — Changing Antifreeze Solution[1]

NOTE

When permanent antifreeze and water solutions are used in the cooling system, the solution should be drained and replaced every 2000 hours, or yearly.

When additions of inhibitor are made to the cooling system every 500 hours, or three months, it is not necessary to drain and refill yearly.

Whenever draining and refilling the cooling system, always recheck the coolant level when the engine reaches normal operating temperature.

Use clean water that is low in scale forming minerals — not softened water.

Check specific gravity of antifreeze solution frequently in cold weather to assure adequate protection.

Add Caterpillar Corrosion Inhibitor. Follow recommendations given on container.

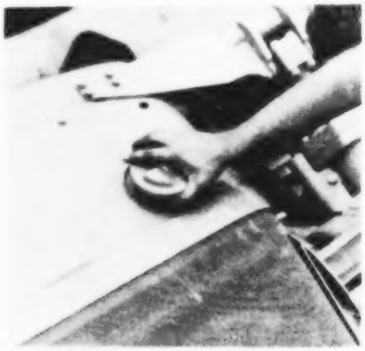
⚠ WARNING

Inhibitor contains alkali, avoid contact with skin and eyes.

NOTE

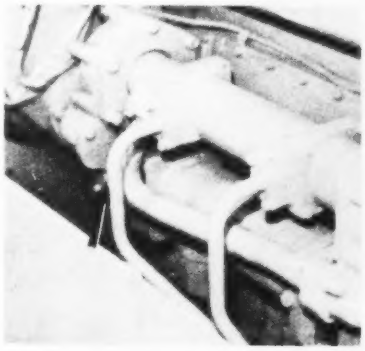
The engine cooling system is protected to −20°F (−29°C), with permanent-type antifreeze, when shipped from the factory.

1. Run engine until coolant is at operating temperature. Park machine on level ground and stop engine.



2. Loosen filler cap slowly to release pressure, and remove filler cap.

3. Open radiator drain valve and allow coolant to drain.



4. Remove transmission — engine oil cooler drain plug and allow coolant to drain.

5. If tractor is equipped with a heater, drain coolant from heater.

6. Close radiator valve and install transmission — engine oil cooler plug.

7. Mix antifreeze solution to provide protection to the lowest expected ambient temperature.

8. Add coolant slowly to proper level.

9. Install radiator filler cap.

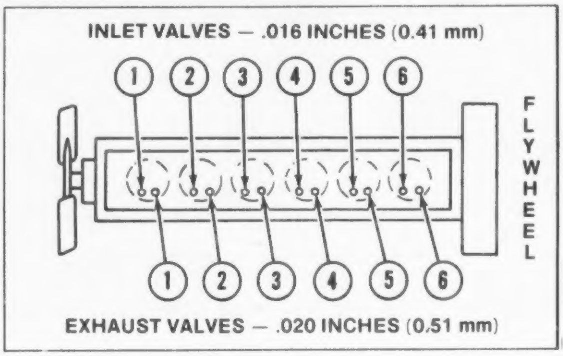
10. Start machine. Recheck level after operating for a short period.

---

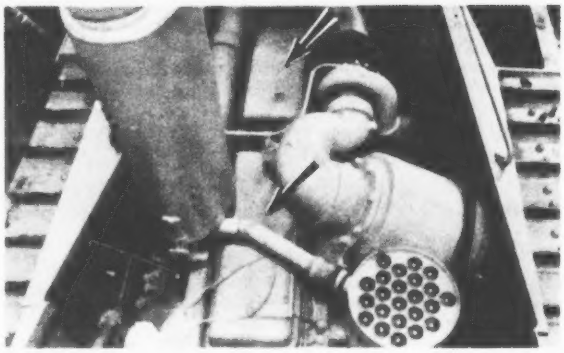
[1] If machine is to be stored in or shipped to an area with below freezing temperatures, cooling system must be drained completely, or protected to lowest expected ambient temperature.

EVERY 2000 SERVICE HOURS OR 1 YEAR

㉞ ENGINE VALVE LASH

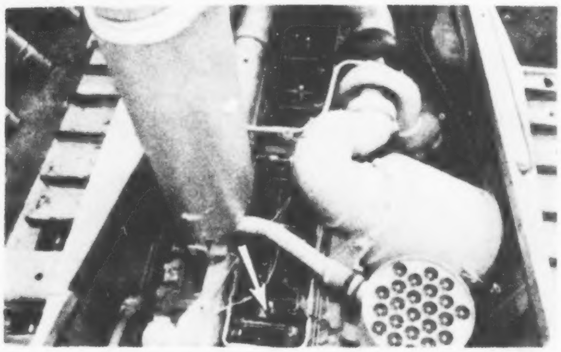

INLET VALVES — .016 INCHES (0.41 mm)
1
2
3
4
5
6
FLYWHEEL
1
2
3
4
5
6
EXHAUST VALVES — .020 INCHES (0.51 mm)

Check valve lash with engine stopped.

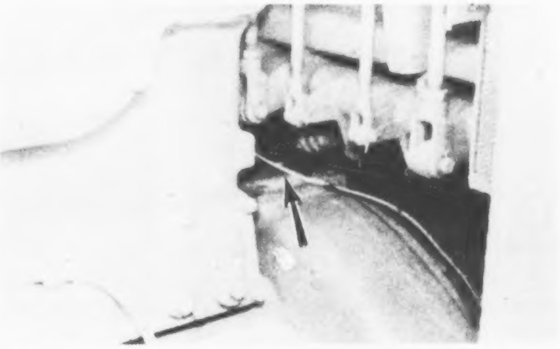


1. Remove valve covers.

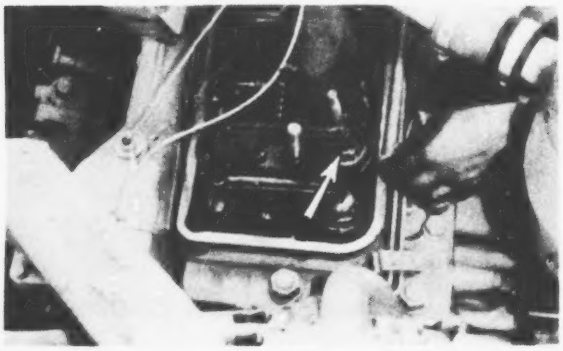
CAUTION
Always turn flywheel in direction of normal rotation.



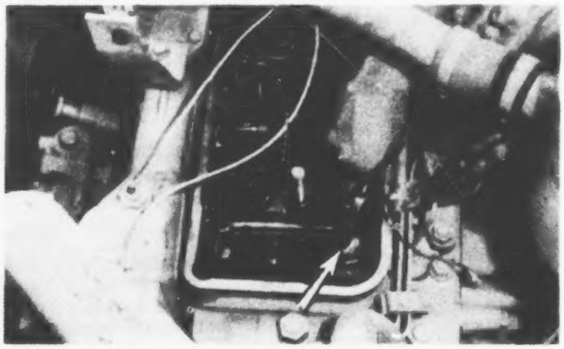
2. Turn flywheel to close No. 1 exhaust and inlet valves.



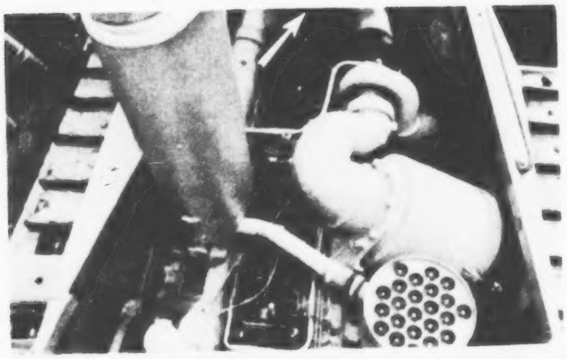
3. Remove cover at the top of the flywheel housing. Indicator should be aligned with the TDC mark on flywheel.



4. Check valve lash for No. 1, No. 3 and No. 5 exhaust valves. Adjust if necessary. See page 24.

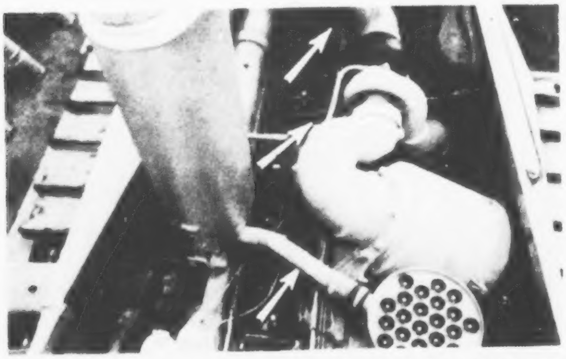


5. Check valve lash for No. 1, No. 2 and No. 4 inlet valves. Adjust if necessary.

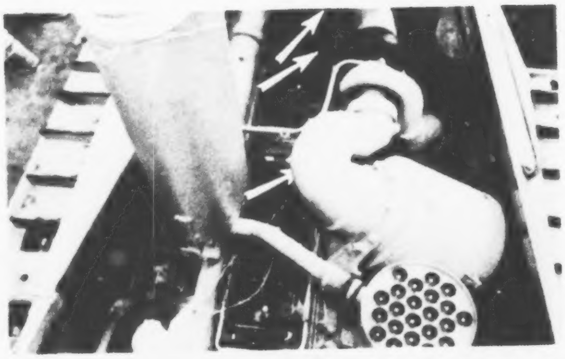


6. Rotate flywheel 360° to close No. 6 exhaust and inlet valves.

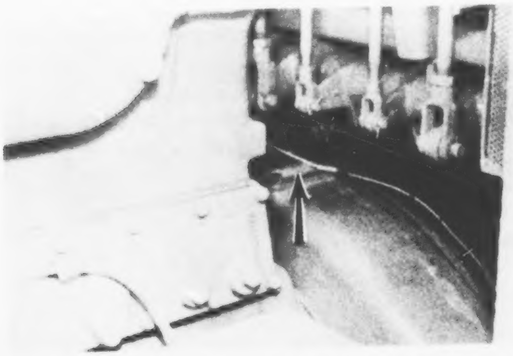
7. Use indicator to assure flywheel is in the correct position.



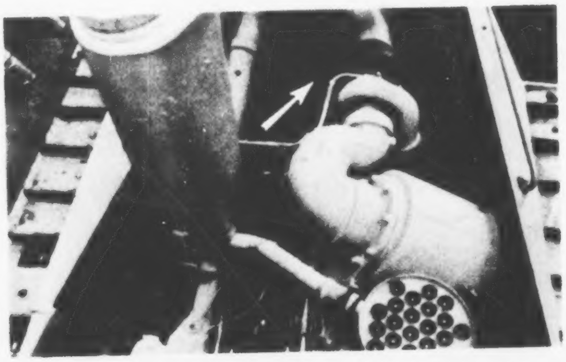
8. Check valve lash for No. 2, No. 4 and No. 6 exhaust valves. Adjust if necessary.



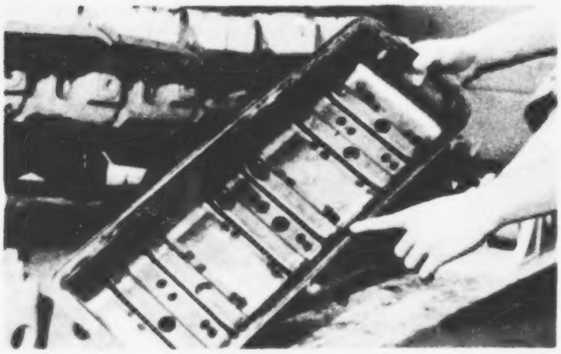
9. Check valve lash for No. 3, No. 5 and No. 6 inlet valves. Adjust if necessary.



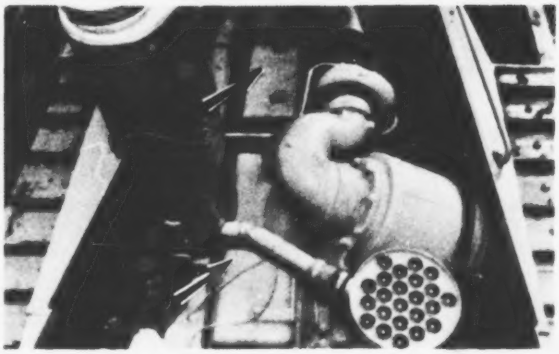
10. Install plate at top of flywheel. Start engine and operate at low idle.



11. Check valve rotation. If valves do not rotate, see your Caterpillar dealer.

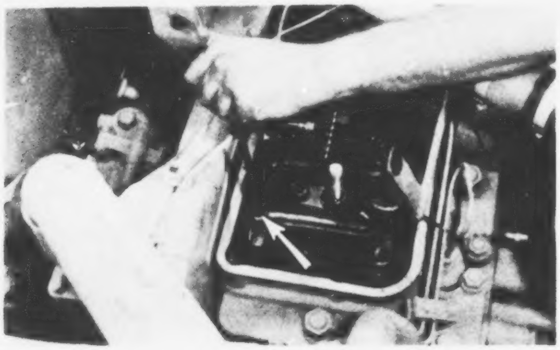


12. Stop engine. Inspect cover gasket, replace if necessary.

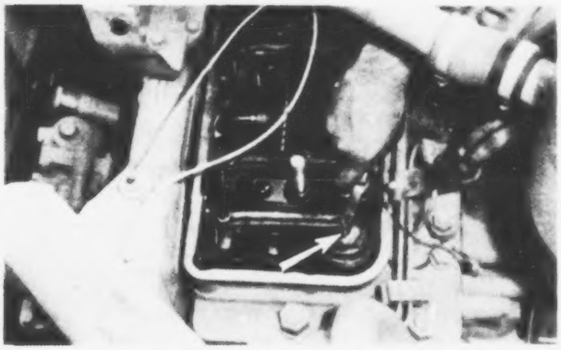


13. Install valve covers, tighten nuts to approximately 25 lb. ft. (3.5 mkg).

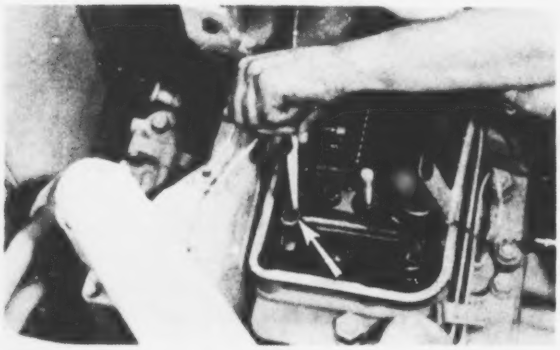
Adjusting Valve Lash



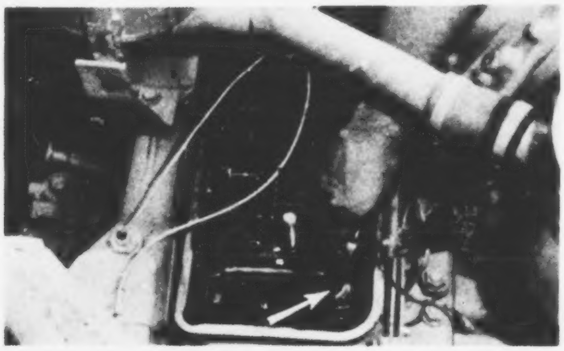
1. Loosen locknut and turn adjusting screw.



2. Check adjustment.



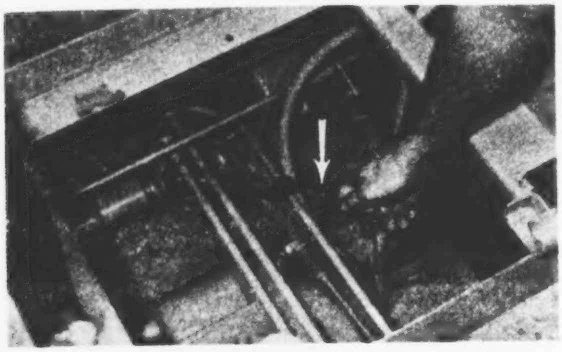
3. Tighten locknut.



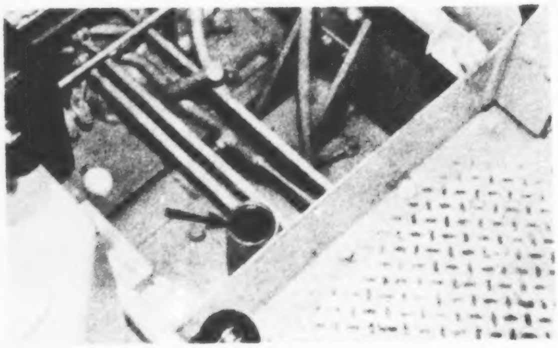
4. Recheck adjustment.

WHEN REQUIRED

㉟ TRANSMISSION, BEVEL GEAR, FLYWHEEL CLUTCH AND STEERING CLUTCH COMPARTMENT

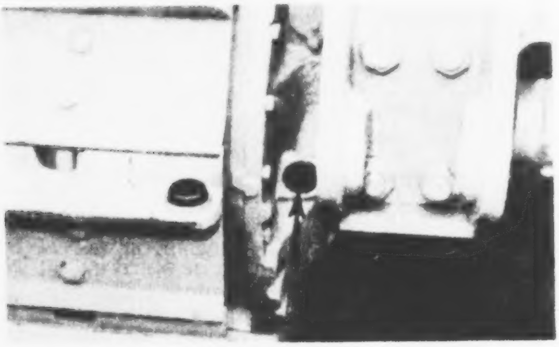


Check oil level with engine at low idle and transmission in NEUTRAL. Maintain oil level between ADD and FULL marks on dipstick.



Add oil if required.

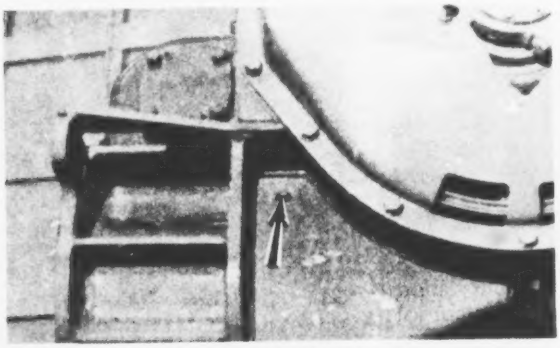
㊱ FINAL DRIVES



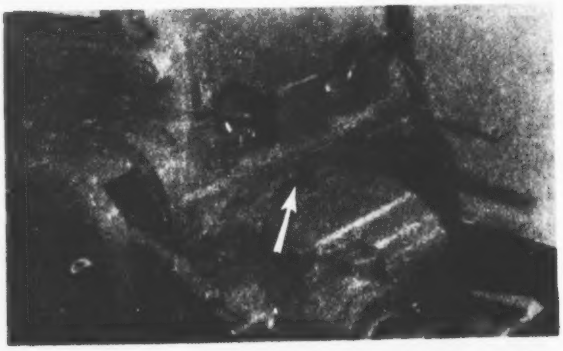
1. Remove fill plug.

2. Check oil level. Oil should be up to the filler plug opening. Add oil as required.

㊲ CABLE CONTROL — Checking Oil Level

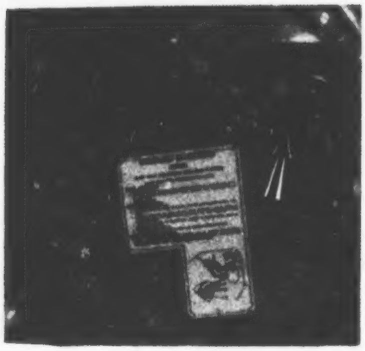


1. Remove check plug.

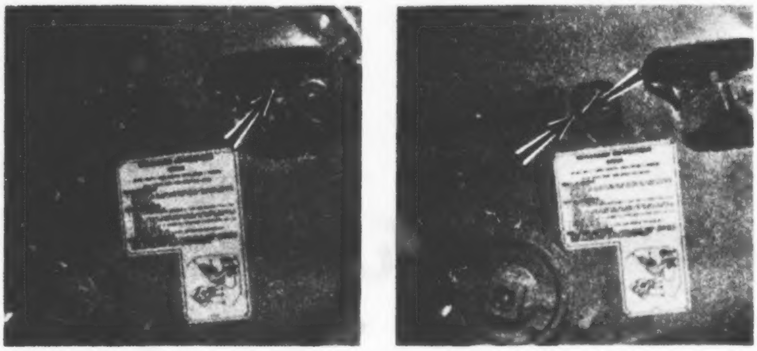


2. Check oil level. Maintain oil level up to the check plug opening. Clean and install check plug.

Brake Adjustment

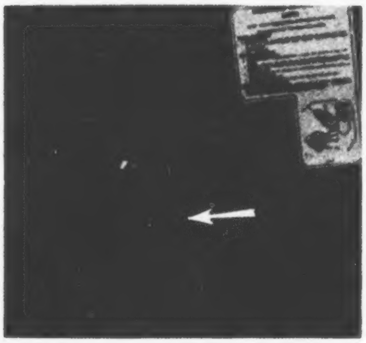


1. Stop engine. Loosen clamp bolt.

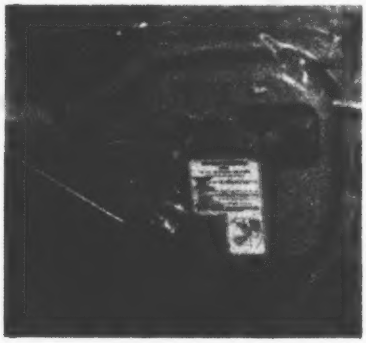


2. Turn adjusting nut to align center of roller and small hole in brake lever. Tighten locknut.

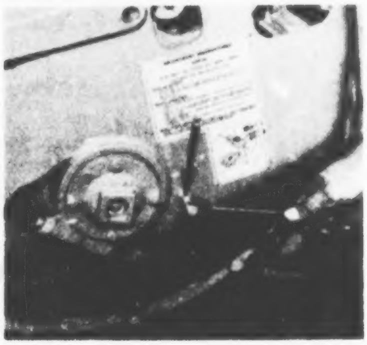
Clutch Adjustment (Adjust brake before adjusting clutch)



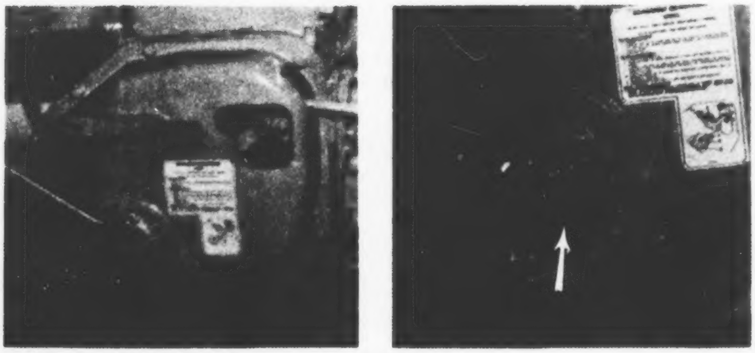
1. Stop engine. Loosen locknut.



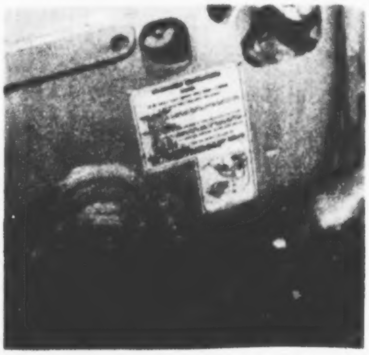
2. Turn adjusting screw counterclockwise until retainer is tight and clutch is engaged.



3. Loosen locknut and turn bolt until it contacts pressure plate retainer. Back bolt out 1 turn.



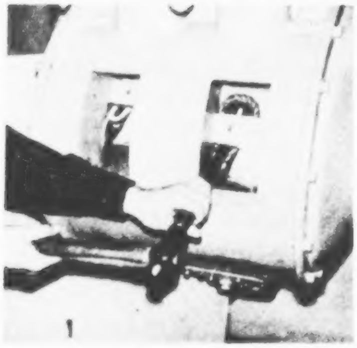
4. Turn adjusting screw until pressure plate retainer contacts bolt. Tighten clamp bolt.



5. Loosen bolt 5 turns. Tighten locknut.

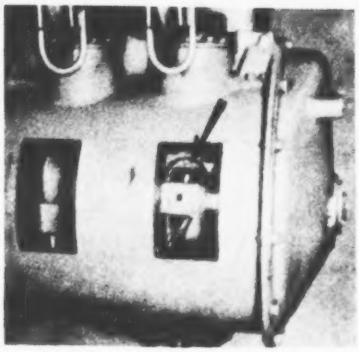
Cable

CAUTION
Check cable for frayed or worn spots. If cable is frayed or worn install new cable.



1. Stop engine. Loosen wedge and remove old cable.

2. Thread new cable.



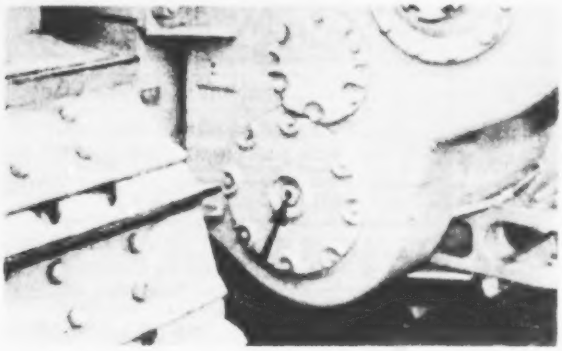
3. Loop end of cable around wedge. Pull cable to tighten wedge.

The recommended cable is: ½", 6 x 25 Filler Wire, Right Lang Lay, Independent Wire Rope Center, Preformed, Improved Plow Steel Type.

MINIMUM AMOUNT OF CABLE ON DRUM

	RIGHT DRUM	LEFT DRUM
Scraper grounded	5-6 Wraps	
Scraper ejector to rear and apron closed		2 Wraps

WINCH



NOTE
Check cable. If cable is worn or frayed install a new cable.

1. Check oil level with engine running at low idle. Oil must be visible in sight gauge. Add oil if necessary.

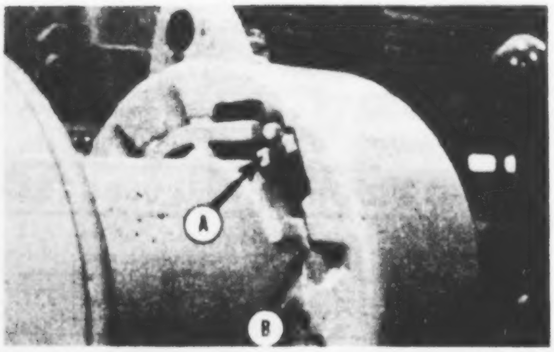
Installing Cable

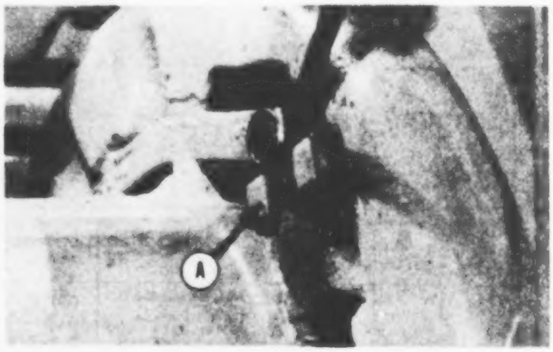
Cable is attached to the drum on the winch with a standard cable ferrule. The ferrule, leaded or wedged to the cable, is fitted into a socket on the drum and secured with a bolt-down clamp.

Ferrules are made in various diameters and lengths. When ordering cable from your local supplier, use the following guide to specify the correct ferrule.

WINCH	CABLE DIAMETER	CABLE FERRULES IN. (mm)		
		Number	Outside Diameter	Length
58	1⅛ (28) 1¼ (32)	J-9 J-10	2⅜ (60) 2⅜ (60)	2¾ (69) 2¾ (69)

NOTE
1¼ in. (32 mm) diameter cable is to be used for extended cable life only. It is not to be used for increasing winch capacity



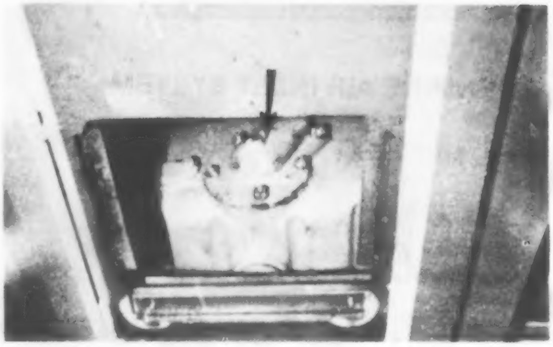


Put the cable in a straight line behind the tractor. Remove clamp (A). Install cable end into groove (B). Install clamp (A).

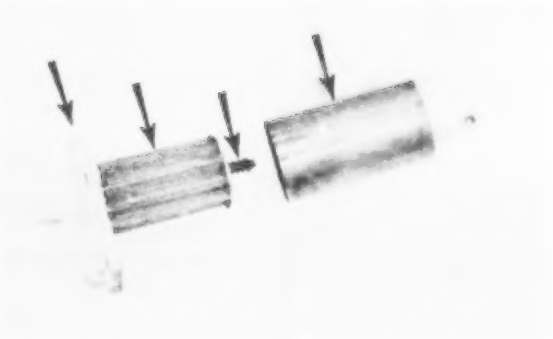
Spool capacity for the 1⅛ in. (28 mm) diameter cable on the 58 winch with a 13 in. (330 mm) diameter spool is 225 ft. (69 m) or 266 ft. (81 m) with a 9.5 in. (241 mm) diameter spool. Spool capacity for the 1¼ in. (32 mm) diameter cable with a 13 in. (330 mm) diameter spool is 178 ft. (54 m) or 211 ft. (64 m) with a 9.5 in. (241 mm) diameter spool.

㊳ FLYWHEEL CLUTCH SUCTION SCREEN

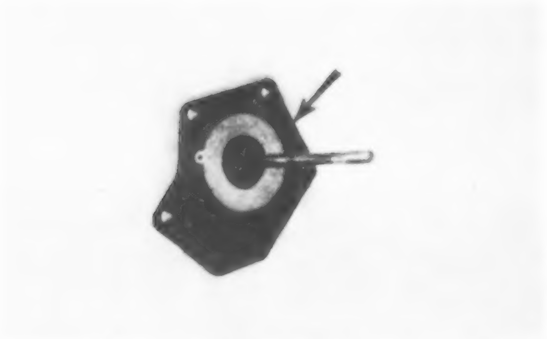
1. Wash suction screen whenever oil becomes thick or at time of repairs on brakes, transmission or flywheel clutch.



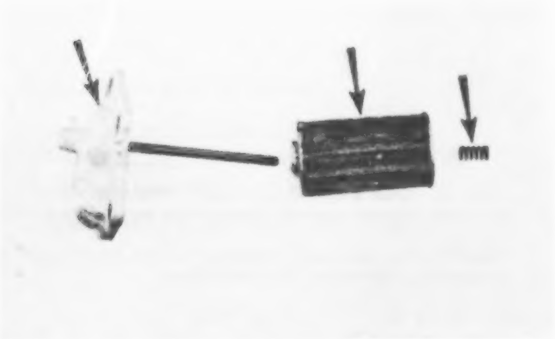
2. Remove cover housing spring and screen.



3. Separate cover, housing spring and screen. Wash screen in clean solvent.



4. Inspect cover gasket. Install new cover gasket if necessary.

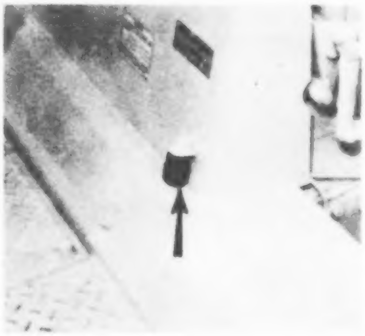


5. Install screen, spring and housing to cover. Be sure pin in housing is aligned with hole in cover.

6. Install suction screen assembly.

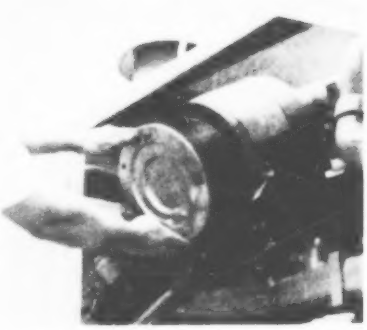
◉ ENGINE AIR INLET SYSTEM

⚠ WARNING
Never service air cleaners with engine running.

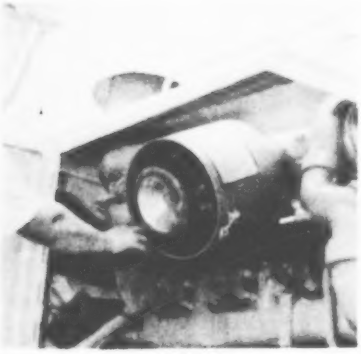


Service filter elements when RED indicator locks in the visible position.

Primary Element



1. Remove cover and primary element.



2. Clean inside of body and cover.

3. Clean and inspect element. (See Page 32).

CAUTION
Always inspect primary element before and after cleaning with a light bulb inside element. Discard if any tears, rips or damage is evident.

4. Install clean element and cover.

5. Reset indicator.

If indicator shows RED shortly after installation of a primary element which has been cleaned approximately 6 times, change to another clean element.

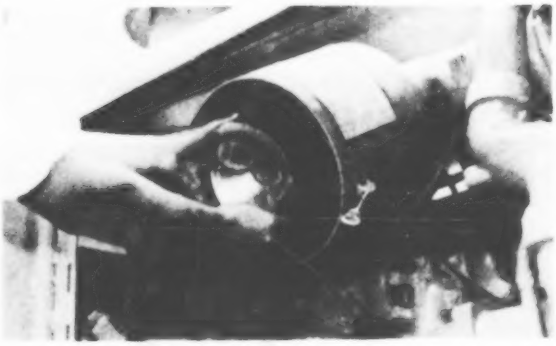
NOTE
The primary element should be replaced after being cleaned a maximum of 6 times. Replace the element once a year even though it has not been cleaned 6 times.

If indicator still shows RED shortly after the installation of the clean primary element, change the secondary element.

Replace the secondary element at the time the primary element is cleaned for the fourth time.

CAUTION
Always replace the secondary element. Do not attempt to reuse by cleaning.

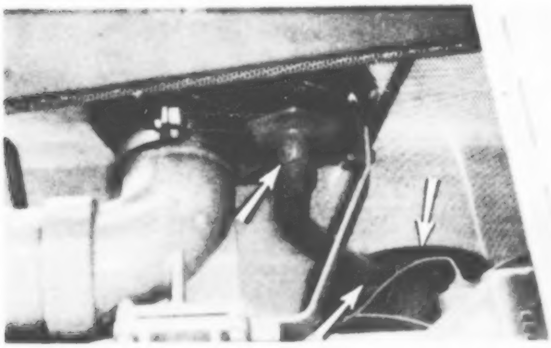
Secondary Element



1. Remove cover and primary element.

2. Remove secondary element.

3. Cover air inlet opening. Clean inside of air cleaner body.



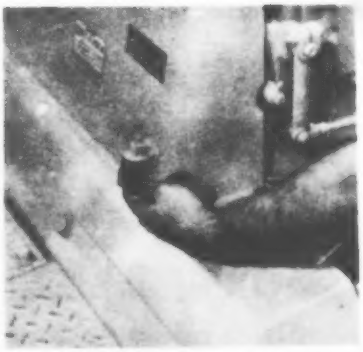
4. Inspect precleaner, dust ejector and exhaust venturi. Clean all parts when necessary.

5. Clean parts with compressed air, a stiff fiber brush or wash in water and non-sudsing detergent. Dry all parts before installation.*

6. Uncover air inlet opening.

7. Install secondary element and retainer. Tighten nuts to 20 ± 5 lb. ft. (2,8 ± 0,7 mkg).

8. Install primary element and cover.



9. Reset filter indicator.

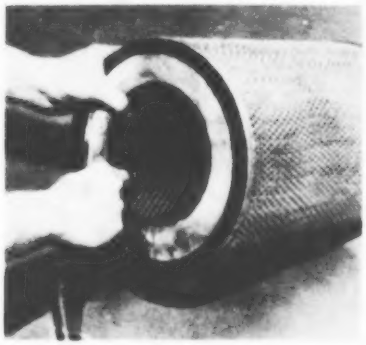
* **⚠ WARNING**

When using pressure air wear safety glasses and protective clothing. Maximum air pressure must be below 30 PSI (2 kg/cm²).

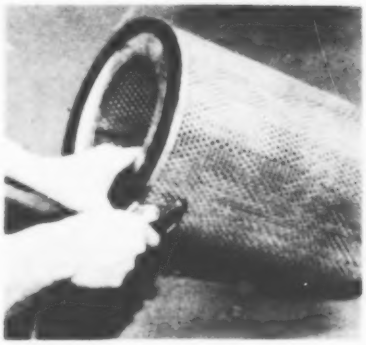
WHEN REQUIRED

CLEANING AIR CLEANER ELEMENTS

Pressure Air — 30 PSI (2 kg/cm²) Maximum

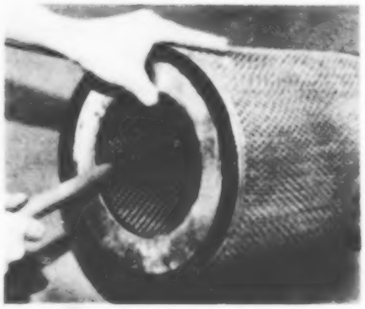


1. Direct air inside element along length of pleats.

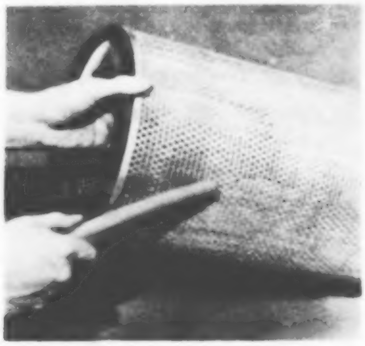


2. Direct air outside along length of pleats. Direct air inside along length of pleats. Check element.

Water — 40 PSI (3 kg/cm²) Maximum

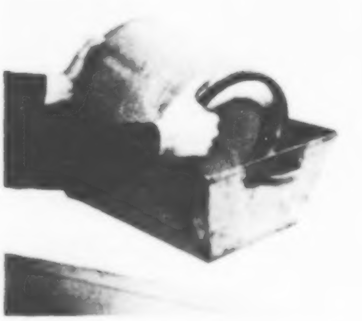


1. Direct water inside element along length of pleats



2. Direct water outside along length of pleats. Rinse, air dry thoroughly and check.

Detergent

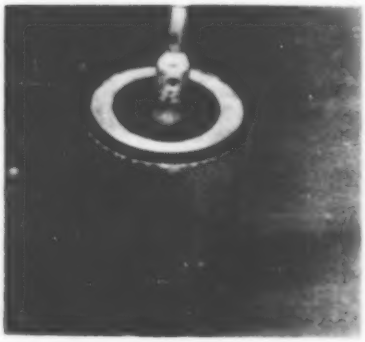


1. Wash in warm water and non-sudsing household detergent.

2. Rinse with clean water, 40 PSI maximum (3 kg/cm²), see above.

3. Air dry thoroughly and check.

Checking Element



1. Insert light inside clean and dry element and check. Discard element if tears or rips are found.

2. Wrap and store good elements in a clean dry place.

⚠WARNING

When using pressure air for cleaning, wear safety glasses and protective clothing. Maximum pressure should be below 30 PSI (2 kg/cm²).

CAUTION

Do not clean elements by bumping or tapping.

Do not use elements with damaged pleats, gaskets or seals.

NOTE

Have spare elements on hand to use while cleaning used elements.

㊶ COOLING SYSTEM

Whenever draining and refilling the cooling system, always recheck the coolant level when the engine reaches normal operating temperature.

Remove cap slowly to relieve pressure. Maintain coolant level to within ½ inch (1 cm) of the bottom of the fill pipe.

Use clean water that is low in scale forming minerals — not softened water.

Never add coolant to an overheated engine. Allow it to cool first.

⚠ WARNING
Inhibitor contains alkali, avoid contact with skin and eyes.

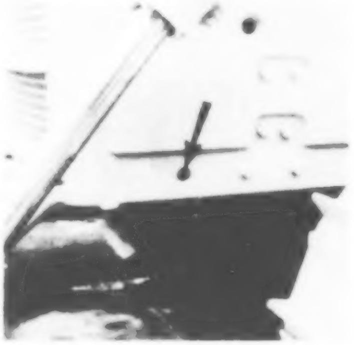
Add Caterpillar Corrosion Inhibitor. Follow recommendations given on container.

Check specific gravity of antifreeze solution frequently in cold weather to assure adequate protection.

NOTE
If a machine is to be stored, or shipped to an area with below freezing temperatures, refer to item 33 on page 21.

Cleaning Cooling System — Run engine until coolant is warm.

1. Stop engine and loosen filler cap to release pressure. Remove filler cap.



2. Open drain valve and allow system to drain.

3. Close drain valve and fill system with cleaning solution.(1)

4. Start engine and operate for ½ hour.

5. Stop engine and open valve. Flush system with clean water until draining water is clear.

6. Close drain valve and fill system with neutralizing solution.(2)

7. Start engine and operate for 10 minutes.

8. Stop engine, open drain valve and flush system.

9. Close drain valve and add coolant to proper level.

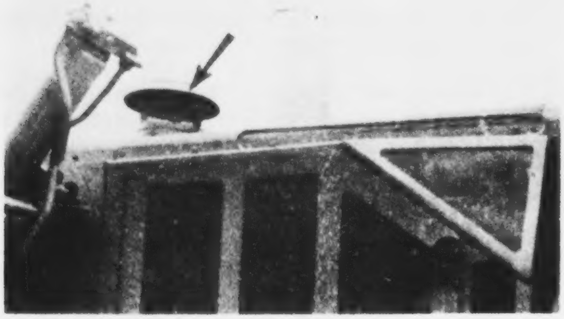
(1) 2 lb. Sodium Bisulphate ($NaHSO_4$) per 10 gal. water (mix 25 grams per 1 liter of water).

(2) ½ lb. Sodium Carbonate Crystals ($Na_2CO_3 \cdot 10\ H_2O$) per 10 gal. water (mix 6 grams per 1 liter of water).

NOTE
Most commercial type cooling system cleaners may be used.

WHEN REQUIRED

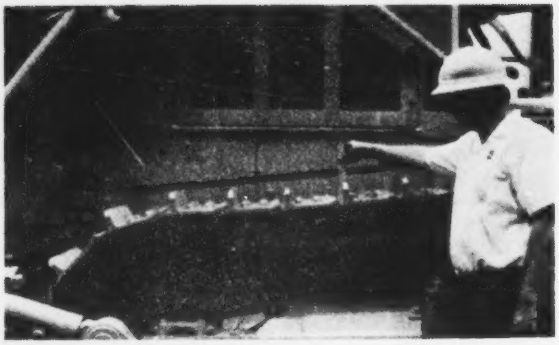
㊷ PRESCREEN



1. Check prescreen for damage and replace if necessary.

2. Wash prescreen in clean solvent, as required, to remove dust and debris on screen.

㊸ TRACK

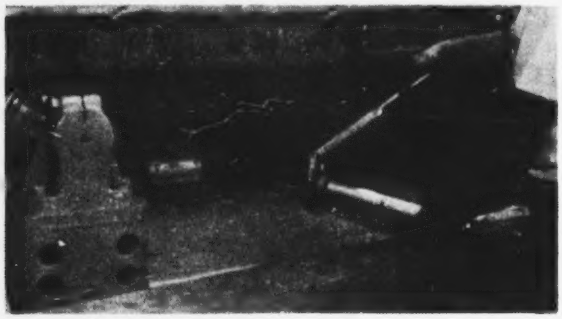


Check adjustment. Correct adjustment allows 1½ to 2 inches (40 to 50 mm) sag at this point.

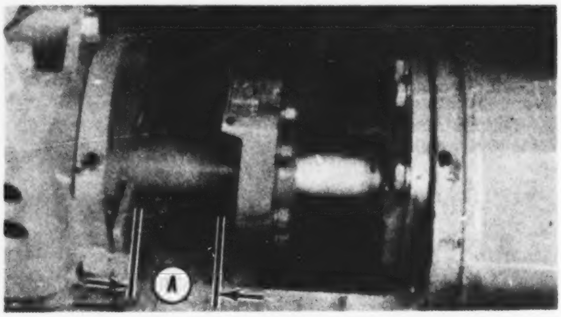
⚠ WARNING

If track is sealed and lubricated type, secure track with chain before separating links. Sealed and lubricated track is very flexible. When disconnected it can move and cause injury.

If Track is Too Loose:



1. Raise inspection plate and add multipurpose-type grease through fill valve until adjustment is correct.



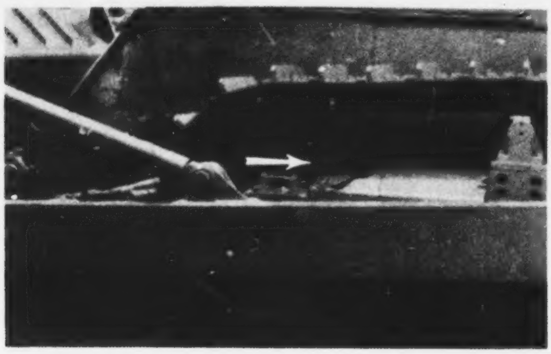
2. Operate tractor back and forth to equalize pressure.

3. Recheck adjustment.

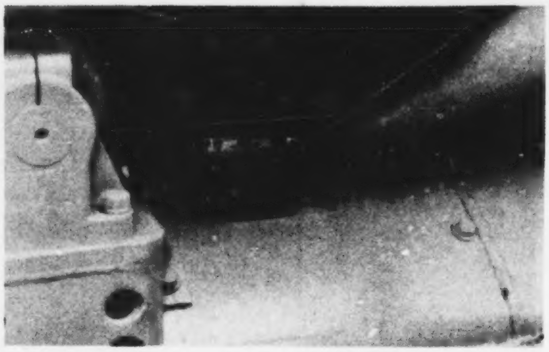
CAUTION

Do not attempt to tighten track when measurement at "A" is less that 1 inch (25 mm). Contact your Caterpillar dealer for track service.

If Track is Too Tight:



1. Be sure front idler can retract. Raise inspection plate.



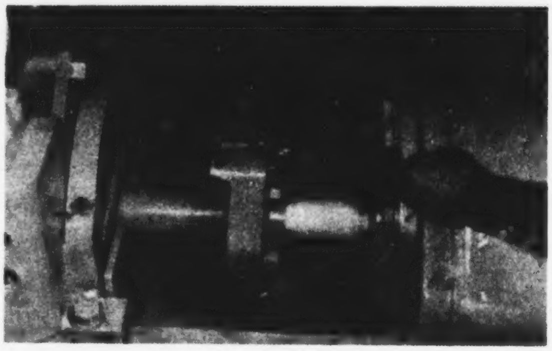
2. Loosen relief valve 1 turn to allow grease to escape.

⚠ WARNING
Never visually inspect relief valve or fill valve to see if grease is escaping. Always observe the track to see if it has loosened.

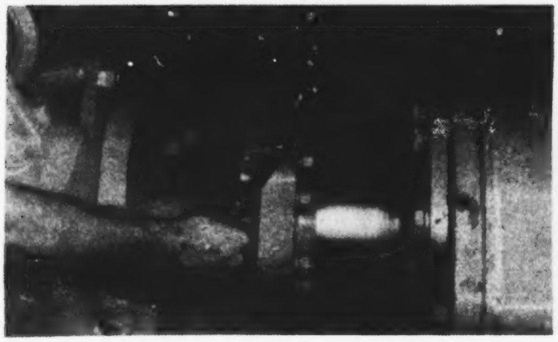
3. Tighten valve when adjustment is correct. Operate tractor back and forth to equalize pressure.

4. Recheck adjustment.

If Track Did Not Loosen:

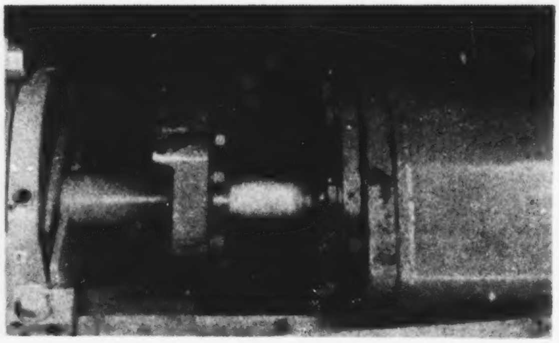


1. Remove guard and loosen fill valve 1 turn. Operate tractor back and forth.



2. Loosen relief valve until it touches guard.

3. Loosen fill valve until it touches guard.

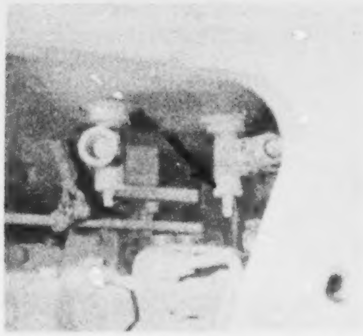


4. Tighten fill and relief valves when adjustment is correct. Contact your Caterpillar dealer if any problems arise.

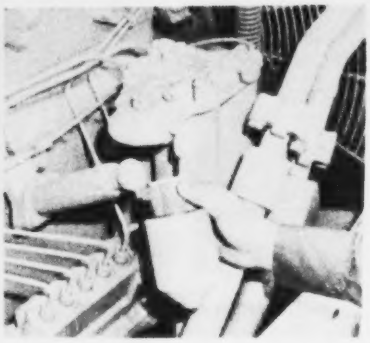
best copy available

㊹ FUEL SYSTEM

Primary Fuel Filter — Clean Element When Fuel Pressure Gauge Registers OUT With Engine Running.



1. Stop engine and close fuel supply valve.



2. Remove case and element. Wash case and element in clean solvent.

3. Install element and case.

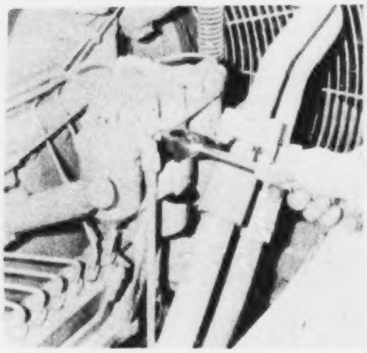
4. Open fuel supply valve.

5. Start engine and check for leaks.

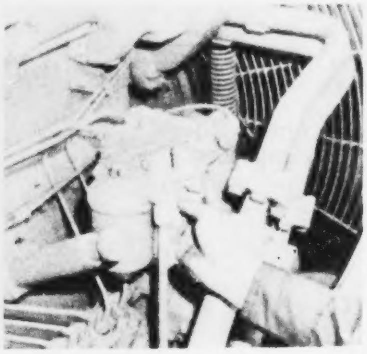
NOTE

Change final fuel filters if fuel pressure gauge still registers OUT with engine running.

Final Fuel Filters



1. Stop engine, close fuel supply valve and remove filters.



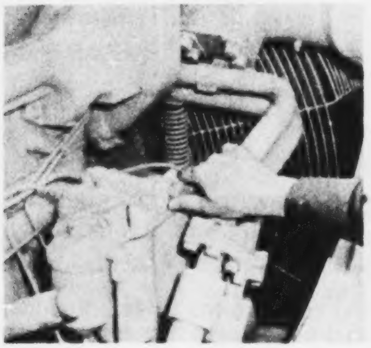
2. Clean filter base. Make sure all of old gasket is removed. Coat gasket of new element with clean diesel fuel.

3. Install new filters. Tighten filters until gasket surfaces contact base, then tighten an additional ½ to ¾ turn.

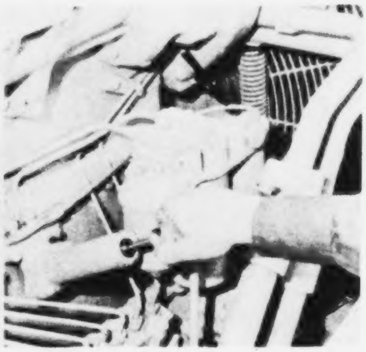
4. Open fuel supply valve and prime fuel system (see below).

5. Start engine and check for leaks.

Priming Fuel System



1. Open bleed valve.

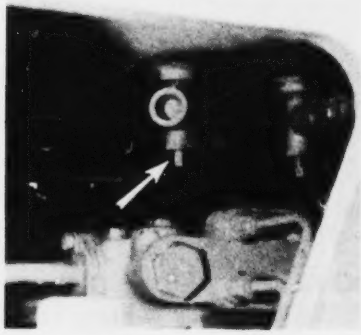


2. Unlock priming pump plunger and operate pump until flow of fuel from drain line contains no air bubbles.

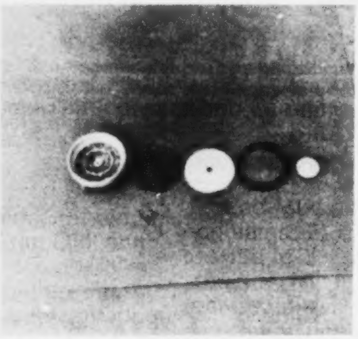
3. Close bleed valve.

4. Start engine and check for leaks.

㊺ DIESEL FUEL TANK AND FILLER CAP



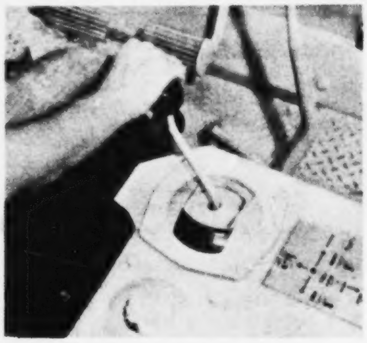
Open drain valve and drain off any sediment or water that may have accumulated.



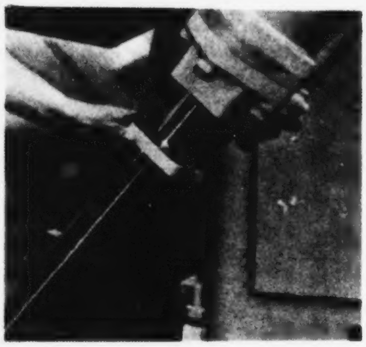
1. Remove and disassemble cap.
2. Wash cap in clean solvent.
3. Oil elements lightly. Assemble and install cap.

㊻ HYDRAULIC CYLINDERS — Shim adjusted rod packing

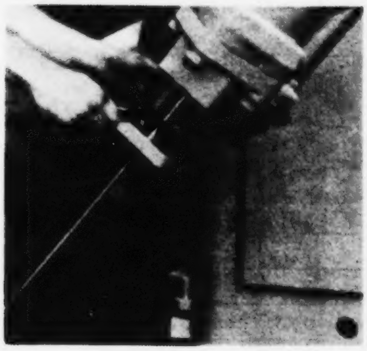
1. Lower blade and stop engine.



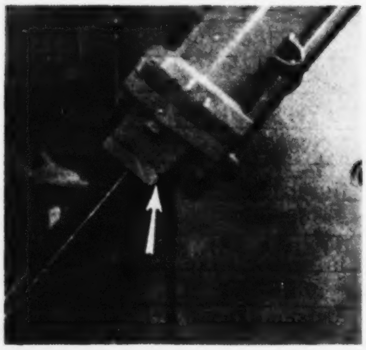
2. Move hydraulic controls to relieve pressure.



3. Remove bolts and slide flange away from cylinder head.



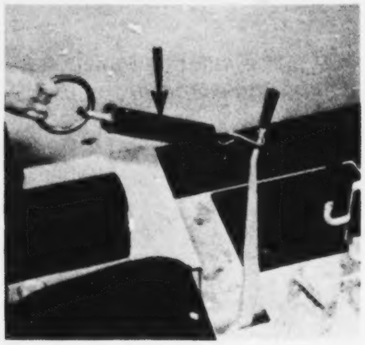
4. Cut and remove 1 shim.



5. Slide flange back and install bolts. Start engine and check for leaks.

6. If still leaking, remove another shim. Leave at least 2 shims. If packing still leaks, see your Caterpillar dealer.

㊼ FLYWHEEL CLUTCH

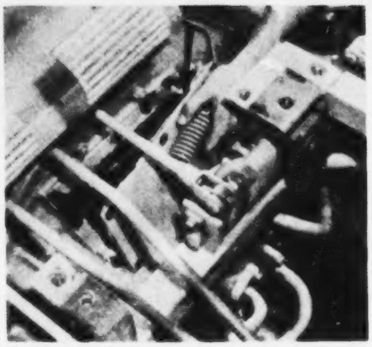


A properly adjusted clutch will require a pull on the clutch lever of approximately 175 pounds (80 kg).

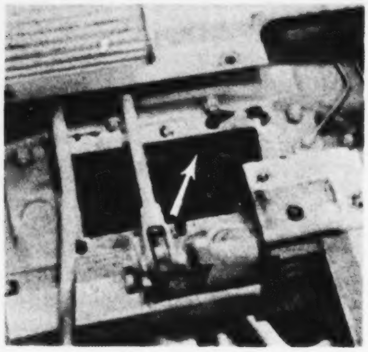
Check adjustment with the engine stopped and the clutch cold.

Slightly more effort may be required if the clutch is warm.

To Adjust:



1. Remove floor plate and clutch compartment cover.

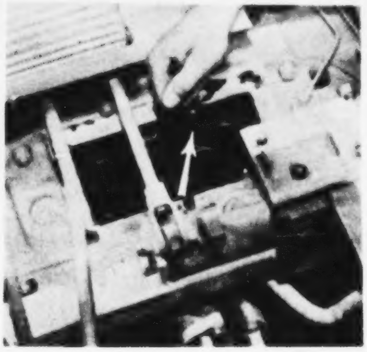


2. Turn flywheel until one of the locks is visible.

3. Loosen locknut 2 turns.

4. Tap plate lightly to be sure it is free on stud.

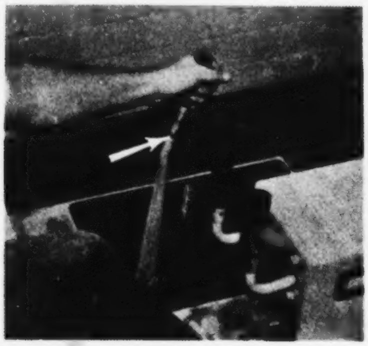
5. Rotate flywheel 180° and loosen other locknut.



6. Turn adjusting ring clockwise to tighten clutch.

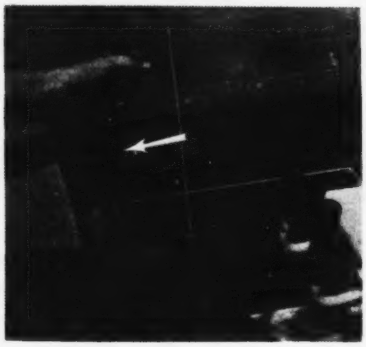
7. Tighten locknuts. Install cover and floor plate.

Clutch Brake Adjustment



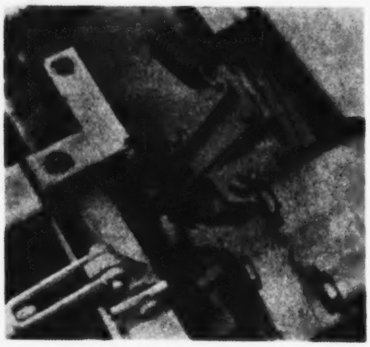
Push clutch control lever forward. If the clutch is slow in stopping, adjust brake.

To Adjust:

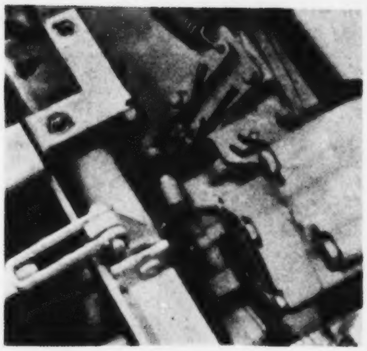


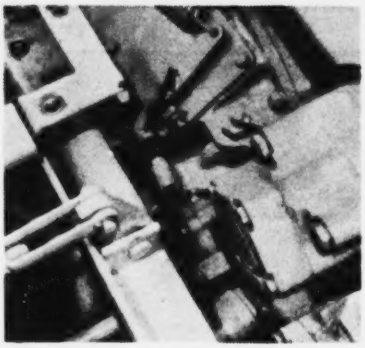
1. Engage clutch.

2. Remove floor plate.

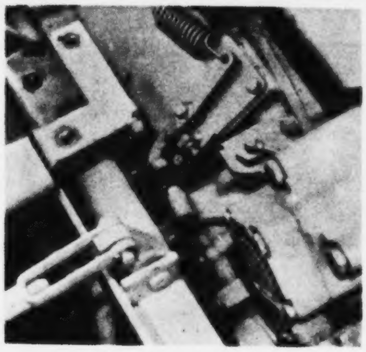


3. Loosen locknut and turn adjusting screw in (clockwise) all the way.



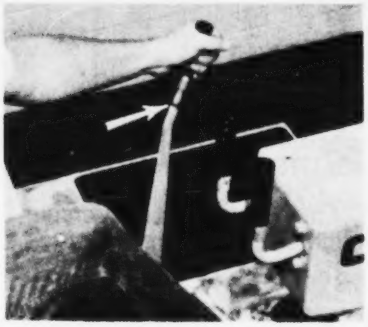


4. Loosen locknut and turn adjusting screw in (clockwise) until there is clearance between release lever and actuating lever. This clearance should exist while pushing actuating lever towards release lever as far as possible.

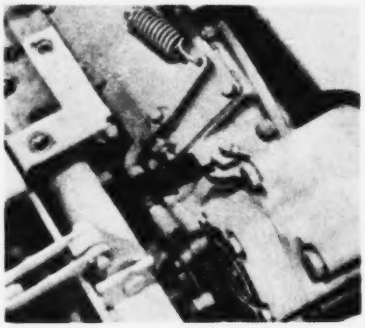


5. Turn adjusting screw out (counterclockwise) until release lever touches actuating lever.

6. Turn adjusting screw out ½ turn more. Tighten locknut.



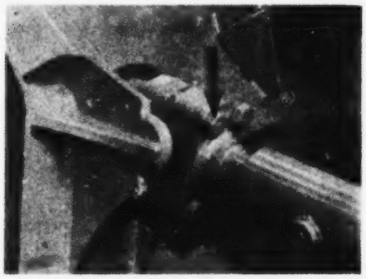
7. Disengage clutch and push lever to extreme forward position. Release lever.



8. Hold actuating lever against release lever and turn adjusting screw out (counterclockwise) until it touches actuating lever. Tighten locknut.

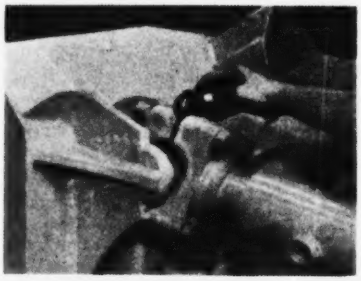
CAUTION
Difficult shifting and excessive brake lining wear will result if the brake is adjusted too tightly.

㊶ BULLDOZER — Diagonal Arm and Tilt Brace Ball and Socket Adjustment



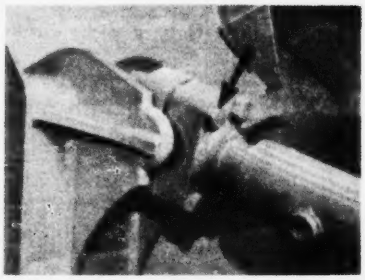
1. Remove cap bolts. Shorten brace and remove shims.

2. Lengthen brace. Install and tighten bolts evenly.



3. Measure clearance between cap and socket with shims.

4. Remove bolts and shorten brace. Install shims equal to measured clearance plus 1 shim.

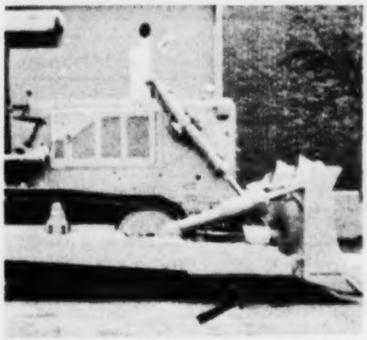


5. Lengthen brace and install bolts.

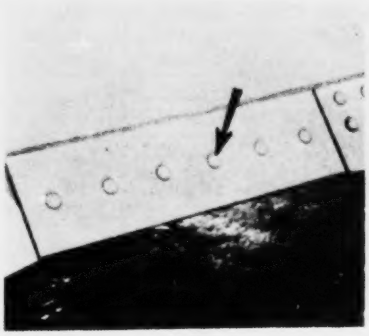
WHEN REQUIRED

㊾ CUTTING EDGE AND END BITS

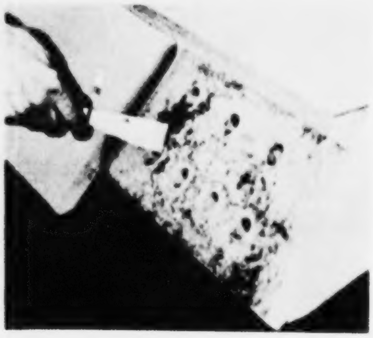
Change cutting edge and use new end bits before wear starts on blade support.



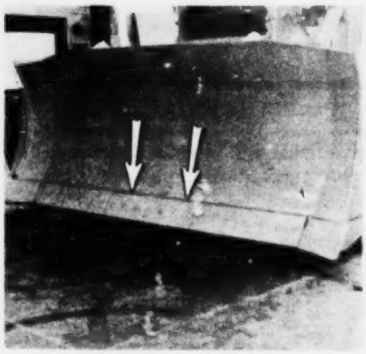
1. Raise and block blade before changing cutting edge or end bits.



2. Remove bolts.



3. Remove cutting edge or bit. Clean contact surfaces.



4. Use opposite cutting edge if not worn. Use new section if both edges are worn.

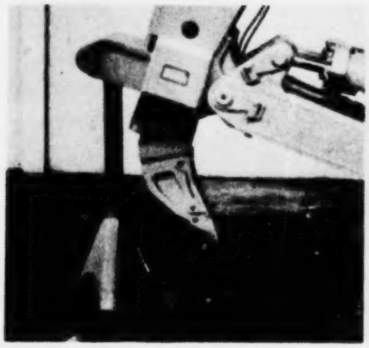
5. Use new end bits.

6. Install bolts and tighten to specified torque. (See PLOW BOLT TORQUE CHART).

7. After a few hours of operation retighten bolts to proper torque.

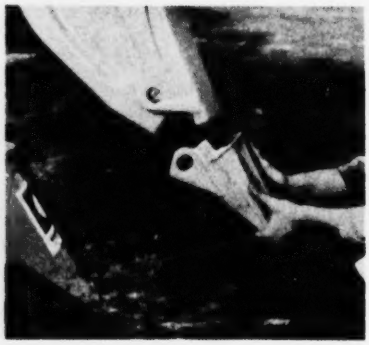
㊿ RIPPER

Protector and Tip



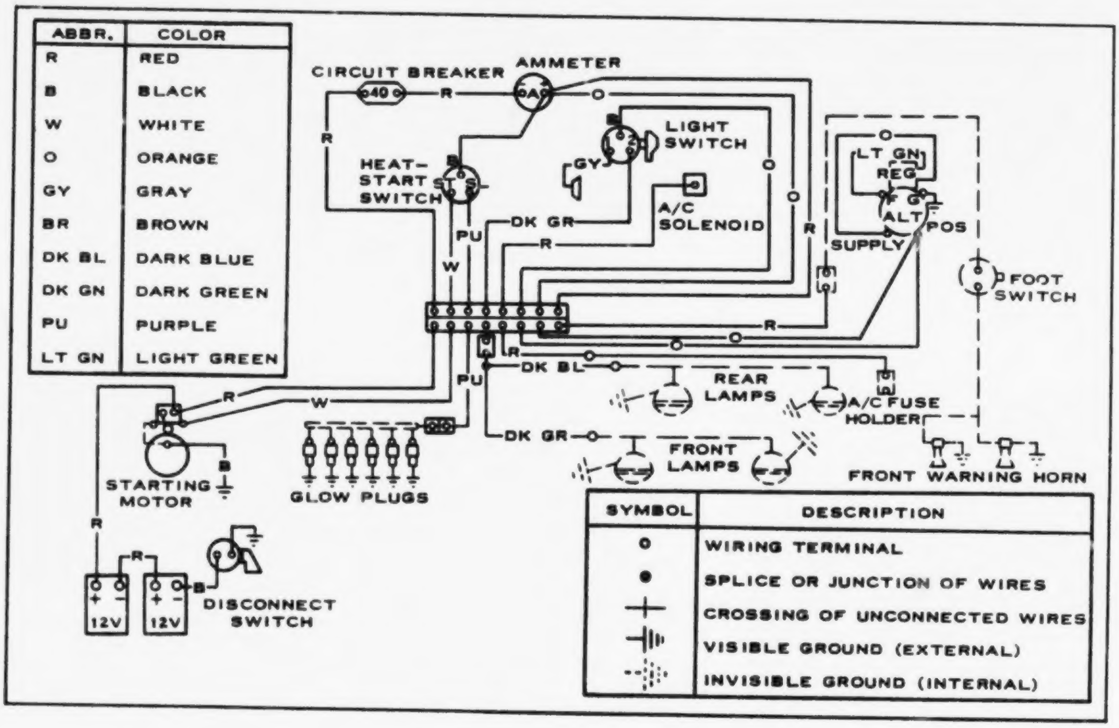
1. Raise and block ripper.

2. Drive pins out, remove protector or tip.
3. Clean pins and shank.



4. Slide new protector or tip on shank and install pins.

24 VOLT SYSTEM WITH ALTERNATOR



ABBR.	COLOR
R	RED
B	BLACK
W	WHITE
O	ORANGE
GY	GRAY
BR	BROWN
DK BL	DARK BLUE
DK GN	DARK GREEN
PU	PURPLE
LT GN	LIGHT GREEN

SYMBOL	DESCRIPTION
○	WIRING TERMINAL
●	SPLICE OR JUNCTION OF WIRES
+	CROSSING OF UNCONNECTED WIRES
⏚	VISIBLE GROUND (EXTERNAL)
⏚	INVISIBLE GROUND (INTERNAL)

CIRCUIT BREAKER
40
AMMETER
A
R
O
LIGHT SWITCH
B
GY
HEAT-START SWITCH
B
ST
S
A/C SOLENOID
DK GR
PU
W
LT GN
REG
F
G
ALT
POS
SUPPLY
FOOT SWITCH
DK BL
REAR LAMPS
A/C FUSE HOLDER
FRONT LAMPS
FRONT WARNING HORN
STARTING MOTOR
GLOW PLUGS
12V
+
-
DISCONNECT SWITCH

COMPARTMENT OR SYSTEM	U.S. MEASURE	METRIC MEASURE	IMPERIAL MEASURE
Diesel engine crankcase	8.75 gal.	33 ltr.	7.25 gal.
Transmission, Bevel Gear, Flywheel Clutch, and Steering Clutch Compartments(1)	35 gal.	132,5 ltr.	29 gal.
Final drives (each)	9.50 gal.	36 ltr.	8 gal.
Cable control gear case	3.75 gal.	14 ltr.	3.25 gal.
Hydraulic system	35 gal.	132,5 ltr.	29.2 gal.
Cooling system	32 gal.	121,2 ltr.	26.7 gal.
Diesel fuel tank	170 gal.	643,5 ltr.	141.6 gal.
Winch oil sump(2)	17 gal.	64,3 ltr.	14.2 gal.

(1) Quantity of oil in transmission may be increased by 10% when operating on severe slopes.
(2) Use same type of oil as used in engine.

Plow Bolt Torque Chart

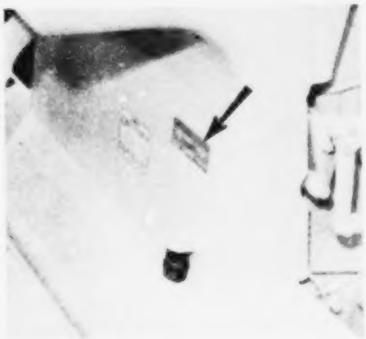
BOLT TORQUE VALUES FOR GROUND ENGAGING TOOLS

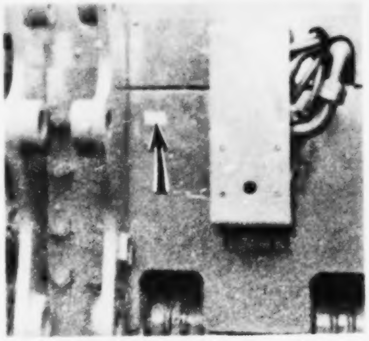
PLOW BOLT SIZE	RECOMMENDED TORQUE*
⅝ in. (16 mm)	195 ± 25 lb. ft. (27 ± 3.4 mkg)
¾ in. (19 mm)	350 ± 50 lb. ft. (48 ± 6.9 mkg)
⅞ in. (22 mm)	565 ± 85 lb. ft. (78 ± 11.7 mkg)
1 in. (25 mm)	900 ± 110 lb. ft. (124 ± 15 mkg)

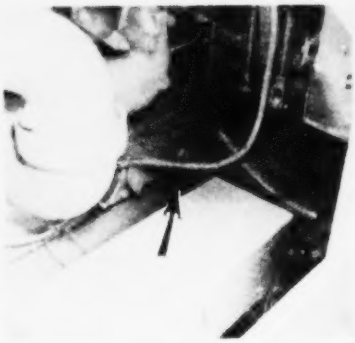
*These values are applicable only to Caterpillar plow bolts.

SERIAL NUMBER LOCATIONS

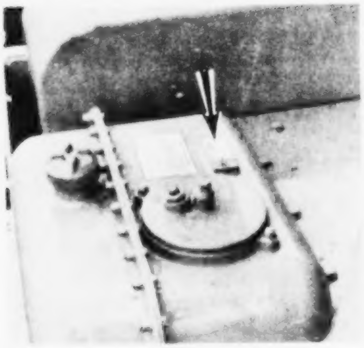
TRACTOR

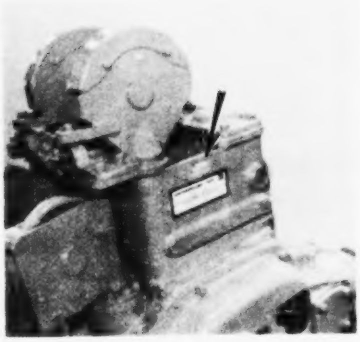

DASH

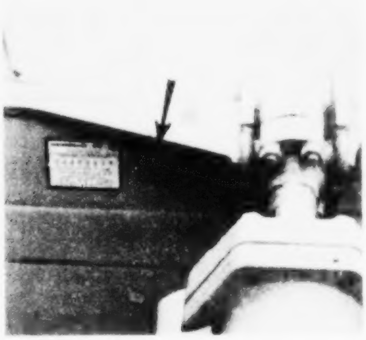

BEVEL GEAR CASE

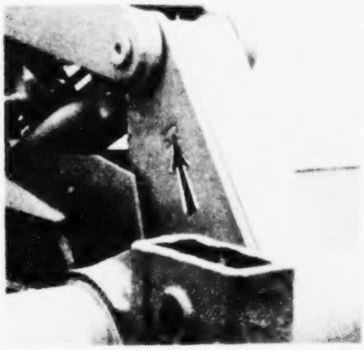

ENGINE

ATTACHMENTS


HYDRAULIC CONTROL


CABLE CONTROL


BULLDOZER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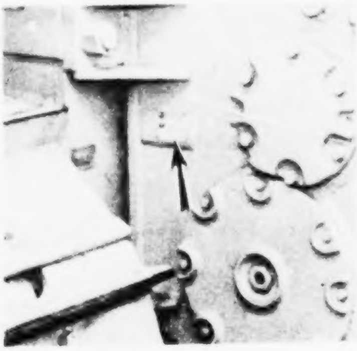
WINCH

CHAPTER 6
SUPPLEMENTAL OPERATING, MAINTENANCE AND REPAIR PARTS INSTRUCTIONS

SUPPLEMENTAL OPERATING MAINTENANCE AND REPAIR PARTS INSTRUCTIONS

FOR

TRACTOR, FULL-TRACKED, LS HDP, DED, (SIZE T-11) CATERPILLAR

MODELS D8K-8A-58 AND D8K-8S-8 (CCE)

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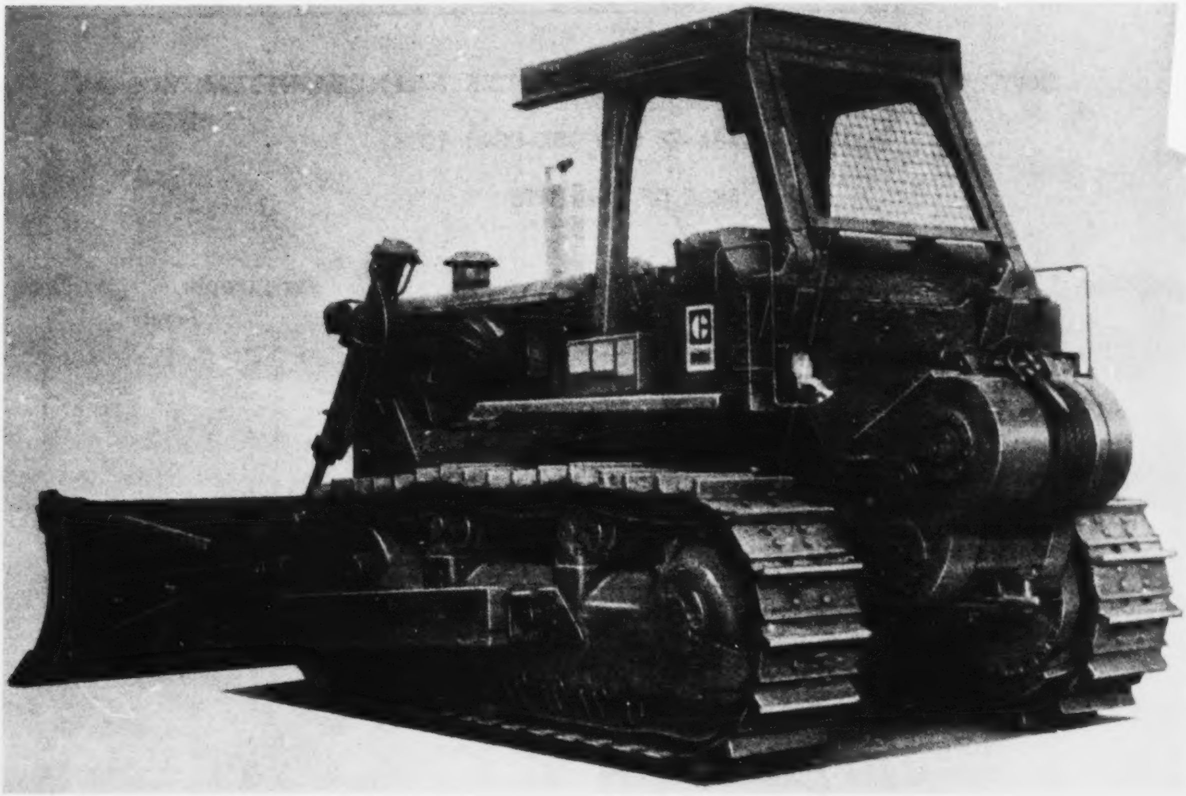


Length: 22.05 feet

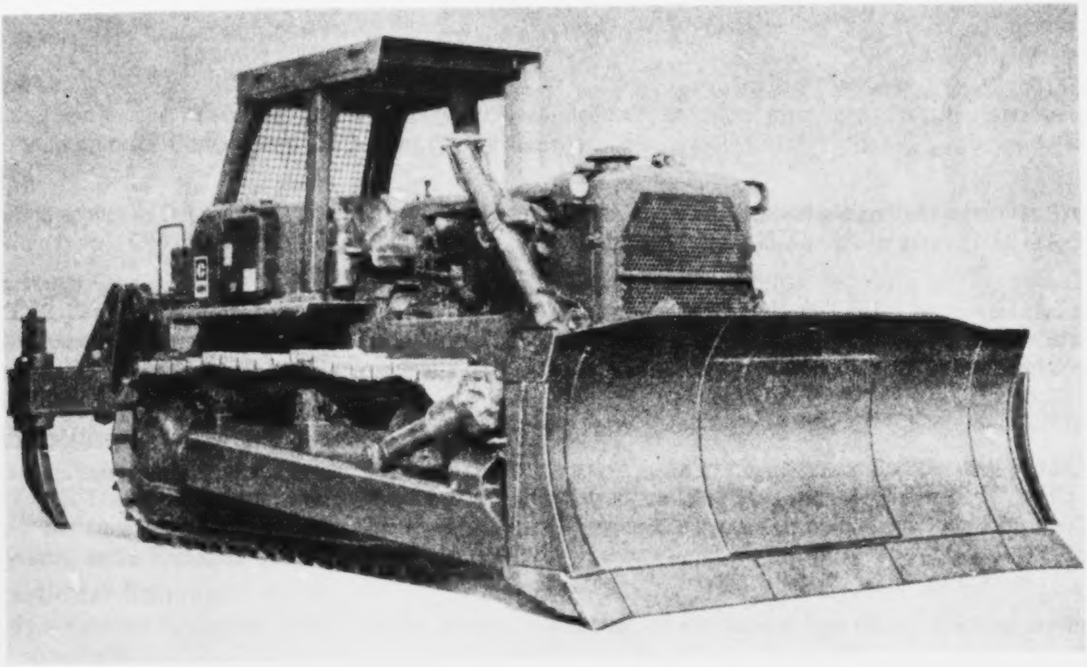
Width: 119 inches

Height: 135 inches

Weight: 75,400 pounds

Weight Load Class: 51

TRACTOR, FULL TRACKED, W/ANGLE DOZER, WINCH AND ROPS



Length: 25.58 feet

Width: 119 inches

Height: 135 inches

Weight: 83,100 pounds

Weight Load Class: 62

TRACTOR, FULL TRACKED W/BULL DOZER (SEMI-U-TILT), RIPPER AND ROPS

Section I
GENERAL

1-1 Purpose

To provide user and support personnel supplemental operator, maintenance, and repair parts instructions that have special application to Commercial Construction Equipment (CCE) items.

1-2 Scope

This publication applies to Department of the Army Units, Organizations, and Activities that use and/or support the Tractor, Size T-11, Type I, Caterpillar Model D8K-8S-8 and the Tractor, Size T-11, Type II, Caterpillar Model D8K-8A-58.

1-3 CCE Item

The term "CCE Item" used in this publication applies to a standard commercial item of construction equipment that has been approved, and is procured and supported under the CCE System Plan. This plan permits maximum utilization of the civilian construction industry's competitive research and development, manufacturer's equipment publications and commercial sources for repair parts.

1-4 Description

The tractors are diesel-engine driven, crawler type, with oscillating tracks and a hydraulic system for operation of attachment. The Type I Tractor is equipped with a Roll-Over-Protective-Structure (ROPS), a Semi-U-Dozer Blade, and a 3-Shank Ripper Bar equipped with two Ripper Shanks. The Type II Tractor is equipped with an Angle Dozer Blade, Cat Model 58 Winch, and a Roll-Over-Protective-Structure (ROPS).

1-5 Operational Concept

The tractors are intended for dozing, ripping, scraper pushing, v-ditching, pit excavation, back filling, winching, towing, and sidehill operations.

1-6 Procurement Status

The procurement contract numbers are:

DSA 700-74-c-9076	*1975*	*1976*
w/Dozer and Winch	32 units	73 units
w/Dozer and Ripper	87 units	149 units
DSA 700-77-c-8591	*1978*	
w/Dozer and Ripper	40 units	

1-7 Equipment Publications

a. Initially two sets of the manufacturer's commercial publications are overpacked and shipped with each tractor (reference appendix A).

b. Additional commercial publications may be obtained by requisitioning from Defense Construction Supply Center (DCSC). Requisitions to DCSC should be prepared in the same manner as for part numbered repair parts, using the Federal Supply Code for Manufacturer's (FSCM) and publication numbers listed in appendix A. If DD Form 1348-6 is used, mail it direct to Commander, DCSC, ATTN: DCSC-OSR, Columbus, OH 43215.

c. Additional copies of this SOMARPI may be obtained by writing to Commander, US Army Tank-Automotive Readiness Command, ATTN: DRSTA-MBS, Warren, MI 48090.

d. If additional assistance is required, contact the address in paragraph 1-11 of this publication.

1-8 Personnel and Training

a. MOS Requirements:

(1) Operator: Crawler Tractor Operator, MOS 62E20.
(2) Organizational Maintenance: Engineer Equipment Repairman, MOS 62B20.
(3) Direct and General Support Maintenance: Engineer Equipment Repairman, MOS 62B30.
(4) Depot Support Maintenance: Engineer Equipment Repairman, MOS 62B40.

b. New Equipment Training: New Equipment Training Teams (NETTs) are available to major field commands. Request for NETTs should be forwarded to Commander, US Army Tank-Automotive Command (TACOM), ATTN: DRSTA-MLT, Warren, MI 48090. Training teams should be requested only when trained personnel are not available in the Command to operate and/or maintain the crawler tractor.

1-9 Logistics Assistance

a. Tank-Automotive Command Field Maintenance Technicians stationed at CONUS and OCONUS installations will be fully qualified and available to furnish on-site training and/or assistance concurrent with receipt of the crawler tractor.

b. Assistance can be obtained by contacting the Logistics Assistance Office listed in appendix B of AR 700-4, Logistics

Assistance Program.

1-10 Warranty

The Caterpillar Tractor Company warrants the products furnished under contract according to the terms and conditions described in the equipment publications and appendix B of this publication. All warranties furnished to the tractor contractor by sub-contractors of assemblies or components utilized in the manufacture of the end item will be extended to the government. See appendix B for warranty guide lines.

1-11 Reporting

You can improve this publication by recommending improvements, using DA Form 2028 (Recommended Changes to Publications and Blank Forms) and mail direct to Commander, US Army Tank-Automotive Material Readiness Command, ATTN: DRSTA-MBS, Warren, MI 48090.

Section II
MAINTENANCE

2-1 Maintenance Concept

The CCE Crawler Tractor will not require any new or special maintenance considerations. All maintenance functions can be accomplished within the current maintenance concepts established for construction equipment.

a. Operator/Crew Maintenance: Operator and crew maintenance is limited to daily preventive maintenance checks and services.

b. Organizational Maintenance: Organizational maintenance services consist of minor repairs and adjustments.

c. Direct Support Maintenance: Direct support maintenance consists of repairs on-site or in direct support unit's shop. Repairs are accomplished with a minimum of tools and test equipment. Maintenance is performed on a repair-and-return-to-user basis, and organizational maintenance repair parts are supplied to using units.

d. General Support Maintenance: General support maintenance units receive equipment for repair and overhaul from direct support unit's, collection points, supply units, and other activities for which they are assigned maintenance support responsibilities. GS Units operate on a repair/overhaul and return to supply system principle.

e. Depot Maintenance: The primary purpose of Depot Maintenance is to augment stocks of serviceable assets which require maintenance that is beyond the capability of General Support Maintenance Activities. Depot Maintenance is usually accomplished in fixed shops and facilities that are government owned and operated, government owned and contractor operated, or contractor owned and operated.

2-2 Maintenance Allocation Chart (MAC)

Maintenance will be performed as necessary by the category indicated in the Maintenance Allocation Chart (appendix C) to retain or restore serviceability. All authorized maintenance within the capability of a using organization will be accomplished before referring the item to support maintenance. Higher categories will perform the maintenance functions of lower categories when required or directed by the appropriate commanders. Using and support units may exceed their authorized scope and functions in the MAC when approval is granted by the next higher support maintenance Commander.

2-3 Modifications

Modifications will be corrected by the tractor manufacturer after the approval of the field campaign or modification plan by TACOM (See appendix D).

2-4 Quality Deficient Report (QDR)

Standard Form 368 (Quality Deficiency Report) was adopted for Equipment Improvement Recommendation (EIR) reporting. This action was taken to standardize reporting within all governmental services. Submissions to be in accordance with TM 38-750 w/changes.

2-5 Maintenance Expenditure Limits

The average life expectancy for the tractor is 18 years.

REPAIR LIMIT	*YEAR*
50%	1983
45%	1985
40%	1987
35%	1989
30%	1991
20%	1993
10%	1995

2-6 Shipment and Storage

a. Refer to TB 740-97-2, Preservation of USAMECOM Mechanical Equipment For Shipment And Storage.

b. Refer to TM 740-90-1, Administrative Storage of Equipment.

2-7 Destruction To Prevent Enemy Use

Refer to TM 750-244-3, Procedures For Destruction of Equipment to Prevent Enemy Use (Mobility Equipment Command).

2-8 Fire Protection

a. A hand operated fire extinguisher may be installed at the discretion of the using unit.

b. Refer to TB 5-4200-200-100, Hand Portable Fire Extinguishers Approved For Army Users.

2-9 Basic Issue Item List (BIIL)

A list of items which accompany the tractor or are required for installation, operation, or operator's maintenance (See appendix E).

2-10 Maintenance and Operating Supply List

A listing of maintenance and operating supplies required for initial operation (See appendix F).

2-11 Tool and Test Equipment Requirements

See Section III of the Maintenance Allocation Chart (MAC).

2-12 Maintenance Forms and Records

Refer to TM 38-750, The Army Maintenance Management System (TAMMS).

Section III
REPAIR PARTS SUPPLY

3-1 General

a. The basic policies and procedures in AR 710-2 (Material Management For Using Units, Support Units and Installation), and AR 725-50 (Requisitioning, Receipt, and Issue System) are generally applicable to repair parts management for CCE items.

b. Manufacturer's parts manuals are furnished with CCE items instead of Department of the Army Repair Parts and Special Tool List (RPSTL).

c. National Stock Numbers (NSN's) are initially assigned only to PLL/ASL parts and major assemblies, i.e., engines, transmissions, etc. Additional NSN's are assigned by the supply support activities as demands warrant.

d. Automated Processing (AUTODIN) of Federal Supply Code Manufacturer (FSCM) part number requisitions, without edit for matching NSN's and exception data, is authorized.

e. Proper use of Direct Support System (DSS) project codes and weapons systems designator codes on parts requisitions is essential.

f. Repair parts are available from commercial sources and may be purchased locally in accordance with AR 710-2 and AR 735-110 (Supply Operations Manual: Volume 1; Distribution System Procedures).

g. Initial Prescribed Load List (PLL) and Authorized Stock List (ASL) will be distributed by US Army Tank-Automotive Command (TACOM), ATTN: DRSTA-FH.

3-2 Prescribed Load List (PLL)

The PLL is a list of repair parts and maintenance related items authorized to be on hand or on order at the unit level in support of organizational maintenance. Normally this is based upon 15-days of supply. Initial issues of the PLL will be shipped concurrently with the tractor to overseas destinations. Parts must be requisitioned as required for tractors delivered in CONUS. Managing activities will follow the procedures established under AR 710-2.

3-3 Authorized Stockage List (ASL)

The ASL represents an initial 45-day supply of repair parts required at Direct and General Support levels. The ASL will be replenished on a demand basis, by the supporting depot for those items with NSN's. Additions or deletions to ASL will be ade when necessary to accommodate changing requirements, incorporating latest stock number changes, and achieve command-wide consistency in use of current item identification.

3-4 Requisitioning Repair Parts

a. Using Units/Organizations: Requisitions (DA Form 2765 Series) will be prepared according to AR 710-2 and local command directives. All requisitions will have the Weapons System Designator Code "36" for Model D8K8A58 or "BH" for Model D8K8S8 (see appendix H, of AR 710-2 entered in the 2nd and 3rd positions of block 18). Units in CONUS will use the appropriate DSS Code "BGW" (see Appendix G) in block 19. Units OCONUS will enter in block 19 Project Code "JZC" (see appendix G).

b. Support Units and Activities:

(1) General: All MILSTRIP requisitions (DD Form 1348 Series) prepared for repair parts support of CCE items will include distribution and project codes, see appendixes H, I, and J.

(2) Distribution Code: Supply customers in CONUS will use code "F" in card column (cc) 54. Customers OCONUS will use the appropriate code from appendix P, paragraph P-3, of AR 725-50. Weapons System Designator Code "36" for model D8K8A58 or "BH" for model D8K8S8 (appendix H, AR 710-2) will be entered in cc 55-56 of all requisitions for parts support for the D8K Tractor.

(3) Project Codes: The project code "BGW" will be entered in cc 57-59 of requisitions used by CONUS customers when requisitioning part numbered parts. Supply customers OCONUS will use project code "JZC" for part numbered parts.

3-5 Submitting Requisitions

a. Using units and organizations will submit DA Form 2765 series requisitions to designated support units or activities in accordance with local procedures.

b. Support units and activities will forward MILSTRIP requisition for NSN parts through the Defense Automated Addressing System (DAAS) to managing supply support activity. Requisitions for part numbered part will be forwarded through DAAS to the Defense Construction Supply Center (DCSC).

NOTE

When the manufacturer's part number and federal supply code for manufacturer (FSCM) exceed the space in card columns 8 thru 22 of A02/A0B requisitions, prepare an A05/A0E requisition (DD Form 1348-6) and mail it to Commander, Defense Construction Supply Center, ATTN: DCSC-OSR, Columbus, OH 43215. The tractor serial number must be cited for each repair part requisitioned.

APPENDIX A
REFERENCES

M 5-2410-234-14&P-2	Operator's, Organizational, Direct Support and General Support Maintenance Manual (Including Repair Parts Information and Supplemental Maintenance and Repair Parts Instructions) For Tractor, Full Tracked, Low Speed, Heavy Drawbar Pull, (Size T-11) W/Angle Dozer, Winch and Rops Caterpillar Model D8K-8A-58 (CCE) NSN 2410-00-574-7597 and W/Bulldozer (Semi-U-Tilt), Ripper and Rops Caterpillar Model D8K-8S-8 (CCE) NSN 2410-00-574-7598 (Volume II)

APPENDIX B
WARRANTY GUIDELINES

All warranties furnished by the contractor are expired.

APPENDIX C
MAINTENANCE ALLOCATION CHART
FOR
TRACTOR, FULL-TRACKED, LOW SPEED; DED
SIZE T-11, CATERPILLAR MODEL D8K
COMMERCIAL CONSTRUCTION EQUIPMENT (CCE)

Section I. INTRODUCTION

C-1. General

This Maintenance Allocation Chart (MAC) designates responsibility for performance of maintenance functions to specific maintenance categories.

C-2. Maintenance Functions

Maintenance functions will be limited to and defined as follows:

a. Inspect. To determine the serviceability of an item and detect incipient failure by comparing its physical, mechanical and/or electrical characteristics with established standards through examination.

b. Test. To verify serviceability and detect incipient failure by measuring the mechanical or electrical characteristics of an item and comparing those characteristics with prescribed standards.

c. Service. Operations required periodically to keep an item in proper operating condition, i.e., to clean (decontaminate), to preserve, to drain, to paint, or to replenish fuel, lubricants, hydraulic fluids, or compressed air supplies.

d. Adjust. To maintain, within prescribed limits, by bringing into proper or exact position, or by setting the operating characteristics to specified parameters.

e. Align. To adjust specified variable elements of an item to bring about optimum or desired performance.

f. Calibrate. To determine and cause corrections to be made or to be adjusted on instruments or test measuring and diagnostic equipments used in precision measurement. Consists of comparison of two instruments, one which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

g. Install. The act of emplacing, seating, or fixing into position an item, part, or module (component or assembly) in a manner to allow the proper functioning of an equipment or system.

h. Replace. The act of substituting a serviceable like type part, subassembly, or module (component or subassembly) for an unserviceable counter part.

i. Repair. The application of maintenance services (inspect, test, service, adjust, align, calibrate, or replace) or other maintenance actions (welding, grinding, riveting, straightening, facing, remachining, or resurfacing) to restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module (component or assembly), end item, or system.

j. Overhaul. That maintenance effort (service/action) necessary to restore an item to a completely serviceable/operational condition as prescribed by maintenance standards (i.e., DMWR) in appropriate technical publications. Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like new condition.

k. Rebuild. Consists of those services/actions necessary for the restoration of unserviceable equipment to a like new condition in accordance with original manufacturing standards. Rebuild is the highest degree of material maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours/miles, etc.) considered in classifying Army equipments/components.

C-3. Column Entries

Columns used in the Maintenance Allocation Chart and entries for these columns are explained below:

a. Column 1, Group Number. Column 1 lists group numbers, the purpose of which is to identify components, assemblies, subassemblies, and modules with the next higher assembly.

b. Column 2, Component/Assembly. Column 2 contains the noun names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. Column 3, Maintenance Functions. Column 3 lists the functions to be formed on the item listed in column 2.

d. Column 4, Maintenance Category. Column 4 specifies, by the listing of a "work time" figure in the appropriate subcolumn(s), the lowest level of maintenance authorized to perform the function listed in column 3. This figure represents the active time required to perform the maintenance function at the indicated category of maintenance. If the number or complexity of the tasks within the listed maintenance function vary at different maintenance categories, appropriate "Work Time" figures will be shown for each category. The number of man-hours specified by the "Work Time" figure represents the average time required to restore an item (assembly, subassembly, component, module, end item or system to a serviceable condition under typical field operating conditions. This time includes preparation time, troubleshooting time, and quality assurance/quality control time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the Maintenance Allocation Chart.

e. Column 5, Tools and Equipment. Column 5 specifies by code, those common tool sets (not individual tools) and special tools, test, and support equipment required to perform the designated function.

f. Column 6, Remarks. Column 6 contains an alphabetical code which leads to the remark in Section IV, Remarks, which is pertinent to the item opposite the particular code.

SECTION II. MAINTENANCE ALLOCATION CHART

FOR
TRACTOR, FULL TRACKED: CATERPILLAR MODEL D8K

(1) Group Number	(2) Component/Assembly	(3) Maintenance Function	(4) Maintenance Category					(5) Tools & Equipment	(6) Remarks
			C	O	F	H	D		
01	ENGINE								
0100	Engine Assembly	inspect	0.4					1	
		test			1.5				
		service	0.5						
		replace			14.0				
		repair				40			
		overhaul					110		
	Engine Mounts	inspect	0.1						
		replace			2.4				
0101	Crankcase, Block, Cylinder Head:							1	
	Block Assembly	replace				40			
		repair				60			
	Head Assembly	replace			15.5				
		repair				24			
0102	Crankshaft:							1	
	Crankshaft	inspect				2.0			
		replace				36			
	Bearings	inspect				2.0			
		replace				8.0			
	Pulley	inspect		0.1					
		replace				1.2			
0103	Flywheel Assembly:							1	
	Flywheel	replace				16			
		repair				18			
	Housing	replace				11			
0104	Pistons, Connecting Rods:							1	
	Pistons, Pins, Rings	inspect				4.0			
		replace				12			
		repair				2.5			

*The subcolumns are as follows:

C—operator/crew F—direct support
D—depot
O—organizational H—general support

(1) Group Number	(2) Component/Assembly	(3) Maintenance Function	(4) Maintenance Category					(5) Tools & Equip-ment	(6) Remarks
			C	O	F	H	D		
	Bearings, Rod	inspect				1.0			
		replace				4.0			
	Rods, Connecting	inspect				1.0			
		replace				12			
0105	Valves, Camshafts, and Timing System:							1	
	Covers, Valve	replace		0.6					
		repair		1.5					
	Rocker Arm Cover	inspect		0.1					
		replace		0.5					
	Rocker Arm Assembly	adjust			2.5				
		replace			3.5				
		repair				5.5			
	Cam Shaft	inspect				2.5			
		replace				6.0			
	Barring Gear, Shaft, and Timing Gear Cover	replace				12			
0106	Engine Lubrication System:							1	
	Pump, Oil	replace				10			
		repair				4.0			
	Pan, Oil	replace			8.5				
		repair			2.0				
	Element, Oil Filter	service	0.1						
		replace		0.4					
	Cooler, Oil	service			0.2				
		replace			1.6				
	Gages, Oil	inspect	0.2						
		replace		1.6					

*The subcolumns are as follows:

C—operator/crew F—direct support D—depot

O—organizational H—general support

(1) Group Number	(2) Component/Assembly	(3) Maintenance Function	(4) Maintenance Category					(5) Tools & Equip-ment	(6) Remarks
			C	O	F	H	D		
	Breather	service	0.5						
		replace		0.2					
	Lines and Fittings	inspect	0.1						
		replace		0.8					
0108	Manifolds:							1	
	Exhaust	inspect		0.1					
		replace			3.0				
0109	Accessory Driving Mechanisms:							1	
	Accessory Drive	replace				7.0			
		repair				8.0			
	Fuel System Drive	time			2.0				
03	FUEL SYSTEM							1,2,5	
0301	Fuel Injector Valves	inspect			4.0				
		replace			3.0				
0302	Fuel Pump:							1	
	Pump, Transfer	service			0.1				
		replace			1.0				
		repair			3.0				
	Pump, Injection	test				2.0			
		replace			6.0				
0304	Air Cleaner:							1	
	Elements, Air Cleaner	service		0.2					
		replace		0.3					
	Indicator,Air Cleaner	inspect		0.1					
		replace		0.3					
0305	TurboCharger:	replace			1.3			1	
		repair				8.4			

*The subcolumns are as follows:

C—operator/crew
F—direct support
D—depot
O—organizational
H—general support

(1) Group Number	(2) Component/Assembly	(3) Maintenance Function	(4) Maintenance Category					(5) Tools & Equipment	(6) Remarks
			C	O	F	H	D		
0306	Tanks, Lines, Fittings:							1	
	Tank, Fuel	inspect	0.1						
		service	0.5						
		replace			3.5				
		repair			6.5				
	Lines, Fuel	inspect	0.3						
		replace		0.5					
		repair		1.0					
	Fittings, Fuel	inspect	0.2						
		replace		0.5					
0308	Engine Speed Governor and Controls:							1	
	Governor Assembly	adjust			1.0				
		replace			6.0				
		repair				24			
	Linkage, Control	adjust			0.5				
		replace			1.7				
0309	Fuel Filters:							1	
	Filter, Fuel	service		0.1					
		replace		0.5					
	Strainer, Fuel	service		0.2					
		replace		0.5					
0311	Engine Starting Aids:							1	
	Glow Plug	inspect		0.2					
		replace		2.0					
04	EXHAUST SYSTEM							1	
0401	Muffler and Pipes:								
	Muffler	inspect	0.1						
		replace		0.5					

*The subcolumns are as follows:
C—operator/crew F—direct support D—depot
O—organizational H—general support

(1) Group Number	(2) Component/Assembly	(3) Maintenance Function	(4) Maintenance Category					(5) Tools & Equipment	(6) Remarks
			C	O	F	H	D		
05	COOLING SYSTEM							1	
0501	Radiator:								
	Radiator	inspect	0.2						
		service	0.1						
		replace		4.0					
		repair			16				
	Cap, Radiator	inspect	0.1						
		replace	0.1						
		repair		0.3					
	Guard, Radiator	replace		1.5					
		repair			1.0				
0503	Water Manifold, Headers, Thermostats and Housing Gasket:							1	
	Thermostat	test		1.0					
		replace		0.5					
	Gasket, Housing	replace		0.8					
	Hoses and Clamps	inspect	0.2						
		replace		1.5					
0504	Water Pump:							1	
	Pump Assembly	inspect	0.1						
		replace			1.0				
		repair			3.0				B
	Lines and Fittings	inspect	0.1						
		replace			0.8				
0505	Fan Assembly:							1	
	Fan	inspect	0.1						
		replace		1.0					
	Belts, Fan	inspect	0.1						
		adjust		0.5					
		replace		0.5					

*The subcolumns are as follows:
C—operator/crew F—direct support
O—organizational H—general support
D—depot

(1) Group Number	(2) Component/Assembly	(3) Maintenance Function	(4) Maintenance Category					(5) Tools & Equipment	(6) Remarks
			C	O	F	H	D		
	Pulley, Fan	replace			1.0				
	Guards, Fan	inspect	0.2						
		replace			1.5				
06	ELECTRICAL SYSTEM							1,2,4	
0601	Alternator	inspect		0.2					
		test			0.5				
		replace		0.5					
		repair			4.0				B
		overhaul				6.0			
0603	Starting Motor	inspect		0.2					
		test			0.2				
		replace		1.5					
		repair			8.0				B
		overhaul				10			
0607	Instrument or Engine Control Panel:							1,2,4	
	Wiring	inspect		0.3					
		replace		4.2					
	Hourmeter	inspect		0.1					
		repair		0.4					C
		replace		0.6					
	Gages	inspect		0.2					
		replace		1.6					
	Dash Lamps and Switches	inspect		0.2					
		replace		0.8					
0609	Lights:							1	
	Head and Tail	inspect	0.2						
		adjust		0.5					
		replace		1.3					
		repair		1.5					

*The subcolumns are as follows:

C—operator/crew F—direct support D—depot

O—organizational H—general support

(1) Group Number	(2) Component/Assembly	(3) Maintenance Function	(4) Maintenance Category					(5) Tools & Equipment	(6) Remarks
			C	O	F	H	D		
0611	Horn:							1	
	Horn, Warning	inspect	0.2						
		replace		0.5					
0612	Batteries, Storage:							1,4	
	Batteries	test		0.4					
		service	0.8						
		replace		1.0					
	Cables, Battery	inspect	0.2						
		replace		0.1					
	Box Battery	inspect	0.1						
		replace		0.1					
0613	Chassis Wiring Harness	inspect		0.3				1,4	
		replace		4.2					
07	TRANSMISSION								
0705	Transmission Shifting Components:							1,2	
	Controls	adjust			1.5				
		replace			3.5				
		repair				2.5			
0708	Torque Converter or Fluid Coupling:							1,2,3	
	Torque Divider	replace				16			
		repair				16			
	Pump, Torque Divider	replace		2.5					
		repair				4.7			
	Relief Valve, Torque Divider	inspect		0.1					
		test				0.5			
		replace		1.1					
		repair				2.7			

*The subcolumns are as follows:

C—operator/crew
F—direct support
D—depot
O—organizational
H—general support

(1) Group Number	(2) Component/Assembly	(3) Maintenance Function	(4) Maintenance Category					(5) Tools & Equipment	(6) Remarks
			C	O	F	H	D		
	Torque Converter	replace			16				
		repair				16			
0710	Transmission Assembly and Associated Parts:							1,2	
	Transmission	inspect		9.3					
		test				2.5			
		service		0.5					
		replace				19.5			
		repair				24			
		overhaul					36		
0721	Coolers, Pumps, Motors:							1,2,3	
	Cooler, Oil	service			0.5				
		replace			1.5				
	Pump, Oil	inspect		0.1					
		test				1.3			
		replace		2.1					
		repair				4.3			
		overhaul				5.3			
	Filter, Oil	service		0.2					
		replace		0.8					
	Strainer, Magnetic	service		0.5					
		replace		0.5					
	Lines & Fittings	inspect	0.1						
		replace		1.5					
08	TRANSFER, FINAL DRIVE, PLANETARY & DROP GEAR BOX ASSEMBLIES								
0801	Final Drive:	service		0.5				1	
		replace				22			
		repair				50			
	Final Drive Case	inspect		1.0					
		replace				50			

*The subcolumns are as follows:

C—operator/crew F—direct support D—depot

O—organizational H—general support

(1) Group Number	(2) Component/Assembly	(3) Maintenance Function	(4) Maintenance Category					(5) Tools & Equipment	(6) Remarks
			C	O	F	H	D		
0804	Lubrication,Cooling Or Hydraulic Components:								
	Pump, Oil	inspect							
		replace							
		repair							
	Element, Filter	replace				0.8			
	Strainer	service				0.5			
		replace				0.5			
09	PROPELLER, PROPELLER SHAFTS, UNIVERSAL JOINTS, COUPLER AND CLAMP ASSEMBLY								
0900	Joint, Universal	inspect			1.5			1	
		replace			2.5				
		repair			1.5				
12	BRAKES								
1201	Hand Brakes:							1	
	Parking Brake	adjust		1.0					
		replace		2.0					
		repair			1.0				
13	WHEELS & TRACKS							1,2	
1301	Suspension Assy:								
	Track Roller Frames	inspect	0.2						
		replace				24			
1302	Track Support Rollers & Brackets:							1,2	
	Carrier and Lower Rollers	inspect	0.5						
		replace			16				

*The subcolumns are as follows:

C—operator/crew F—direct support

D—depot

O—organizational H—general support

(1) Group Number	(2) Component/Assembly	(3) Maintenance Function	(4) Maintenance Category					(5) Tools & Equipment	(6) Remarks
			C	O	F	H	D		
1302	Track Idlers and Brackets:							1,2	
	Idlers, Track	inspect	0.5						
		adjust		2.0					
		replace			10				
		repair				16			
	Cylinder, Track Adjuster	inspect	0.5						
		adjust		0.2					
		replace			8.0				
		repair					16		
1304	Track Drive Sprockets:	inspect		0.1				1,2	
		replace			1.7				
1305	Track Assembly:	inspect	0.1					1,2	
		adjust	0.5						
		replace			3.0				
		repair				26			
	Shoes, Track	inspect	0.1						
		replace			24				
14	STEERING								
1403	Steering Brakes:							1,2	
	Controls	inspect	0.4						
		service	0.2						
		adjust		0.5					
		replace		3.5					
	Brake & Linings	replace			16				
		repair				24			
	Clutch, Steering	replace				42			
		repair				42			
1414	Steering System Valves:							1,2	
	Valve, Control Steering Clutch	replace				4.0			
		repair				4.0			

*The subcolumns are as follows:

C—operator/crew

O—organizational

F—direct support

H—general support

D—depot

(1) Group Number	(2) Component/Assembly	(3) Maintenance Function	(4) Maintenance Category					(5) Tools & Equipment	(6) Remarks
			C	O	F	H	D		
15	FRAME, TOWING ATTACHMENTS AND DRAWBARS								
1501	Frame Assembly:							1,2	
	Track Frame and Roller Guard	inspect				0.5			
		replace				8.9			
16	SPRINGS AND SHOCK ABSORBERS								
1605	Torque, Radius, and Stabilizer Rods:							1,2	
	Equalizer Bar	inspect				1.0			
		replace				8.0			
		repair				4.0			
18	BODY, CAB, HOOD AND HULL								
1801	Body, Cab, Hood, and Hull Assy's:							1,6	
	Rops	inspect	0.5						
		replace			8.0				
	Cable Assembly	inspect	0.1						
		replace		2.0					
		repair		1.0					
	Guards, Crankcase	inspect		0.2					
		replace		4.0					
		repair			6.0				
	Hood and Side Panels	inspect	0.2						
		replace		1.0					
		repair			1.0				
1802	Fenders:	inspect	0.1						
		replace		0.8					

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(1) Group Number	(2) Component/Assembly	(3) Maintenance Function	(4) Maintenance Category					(5) Tools & Equipment	(6) Remarks
			C	O	F	H	D		
1805	Floors, Subfloors and Related Components:							1	
	Floor Boards	inspect	0.1						
		replace		0.9					
1806	Upholstery Seats and Carpets:							1	
	Seats	service	0.5						
		replace		2.5					
		repair			4.1				
1808	Stowage Racks, Boxes, Straps, Carrying Cases, Etc:							1	
	Tool Box	inspect	0.1						
		replace			0.8				
20	HOIST, WINCH, CAPATAN WINDLASS, POWER CONTROL UNIT, AND POWER TAKE-OFF							1	
2001	Winch Assy:	inspect	0.1						
		service	0.5						
		replace		16					
		repair			24				
		overhaul				32			
	Winch Control Assembly	adjust		0.5					
		replace		2.0					
		repair			3.1				
	Cable Assy	inspect	0.1						
		replace		2.0					
		repair		1.0					

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C—operator/crew F—direct support D—depot

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(1) Group Number	(2) Component/Assembly	(3) Maintenance Function	(4) Maintenance Category					(5) Tools & Equipment	(6) Remarks
			C	O	F	H	D		
22	BODY, CHASSIS, OR HULL AND ACCESSORY ITEMS								
2202	Accessory Items:	replace		0.8				1	
2210	Data Plates and Instruction Holders:							1	
	Data and Instruction Plate	inspect	0.1						
		replace		1.5					
24	HYDRAULIC AND FLUID SYSTEMS								
2401	Pump and Motor:							1,2,3	
	Pump	inspect		0.1					
		test			1.3				
		replace			2.0				
		repair			4.5				
	Pump Drive	replace			1.3				
		repair			6.5				
2402	Manifold and/or Control Valve:							1,2,3	
	Control Valve	adjust			0.2				
		replace			5.3				
		repair			4.5				
2403	Hydraulic Controls and/or Manual Controls:							1	
	Control Levers and Linkage	adjust		1.2					
		replace			2.1				
		repair			2.2				
2404	Tilt Cylinders and Tilt Crank:							1,3	
	Tilt Cylinder	replace		1.0					
		repair			3.5				

*The subcolumns are as follows:

C—operator/crew
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(1) Group Number	(2) Component/Assembly	(3) Maintenance Function	(4) Maintenance Category					(5) Tools & Equipment	(6) Remarks
			C	O	F	H	D		
	Tilt Brace	replace		0.8					
		repair			1.5				
2406	Strainers, Filters, Lines, and Fittings:							1	
	Cylinder Lines and Fittings	inspect	1.0						
		replace		21					
	Cylinder Hose	inspect	0.1						
		replace		2.5					
	Strainer Assy	service		0.5					
		replace		0.3					
2407	Hydraulic Cylinders:							1,3	
	Lift Cylinder	replace		1.3					
		repair			4.0				
	Ripper Cylinder	replace		1.4					
		repair			3.5				
2408	Liquid Tanks or Reservoirs:							1	
	Hydraulic Tank	inspect		0.1					
		service		0.5					
		replace			4.5				
		repair				8.0			
47	GAGES (NON-ELECTRICAL), WEIGHING, AND MEASURING DEVICES								
4702	Gages, Mountings, Lines, and Fittings:	inspect	0.2						
		replace		1.6					
4703	Hourmeter:	inspect	0.1					1	
		replace		0.6					

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C—operator/crew
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(1) Group Number	(2) Component/Assembly	(3) Maintenance Function	(4) Maintenance Category					(5) Tools & Equipment	(6) Remarks
			C	O	F	H	D		
74	EARTH MOVING EQUIPMENT COMPONENTS								
7435	Moldboard Assy:							1	
	Bull Dozer Cutting Edge	inspect	0.1						
		replace		1.5					
	Bull Dozer End Bit	inspect	0.1						
		replace		2.0					
	Blade Assembly	inspect	0.1						
		replace		2.0					
		repair			16				
7465	Ripper:							1	
	Ripper Assembly	service	0.1						
		adjust		0.2					
		replace			8.0				
		repair				24			
	Ripper Teeth	inspect	0.2						
		replace		1.0					
76	FIRE FIGHTING EQUIPMENT COMPONENTS								
7638	Portable Fire Fighting Equipment:							1	
	Fire Extinguisher	inspect	0.1						
		service		0.4					
		replace		0.2					

*The subcolumns are as follows:
C—operator/crew F—direct support D—depot
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SECTION III. TOOL AND TEST EQUIPMENT REQUIREMENTS

TOOL OR TEST EQUIPMENT REFERENCE CODE	MAINTENANCE CATEGORY	NOMENCLATURE	NATIONAL/NATO STOCK NUMBER	TOOL NUMBER
	Unless otherwise noted, all maintenance functions can be accomplished with the tools contained in the following common tool sets.			
1	O, F, H	Shop Equip Contact Maint, TRK MTD (SC4940-97-CL-E05)	4940-00-294-9518	T10138
1	O, F, H	Shop Equip ORG Repair, Light TRK MTD (SC4940-97-CL-E04)	4940-00-294-9516	T13152
1	O, F, H	Tool Kit Automotive Maint, ORG Maint Common #1 (SC 4910-95-CL-A74)	4910-00-754-0654	W32593
1	O, F, H	Tool Kit Automotive Maint, ORG Maint Common #2 (SC 4910-05-CL-A72)	4910-00-754-0650	W32730
1	O, F, H	Tool Kit, Light Weight (SC-5180-90-CL-W26)	5180-00-177-7033	W33004
1	O, F, H	Shop Equip Auto Maint and Repair, ORG Maint Supp #1 (SC-4910-95-CL-A73)	4910-00-754-0653	W32867
1	O, F, H	Shop Equip Welding, Field Maint (SC 3470-95-CL-A08)	3470-00-357-7268	T16714
1	O, F, H	Tool Set, VEH Full Tracked Sugg #2 (SC4940-95-CL-A08)	4940-00-754-0743	W65747
1	O, F, H	Wrench, Torque: 3/4" Drive 500 lbs. capacity	5120-00-542-5577	Y84966
2	F, H	Shop Equip GEN PURP Repair, Semi Trlr MTD (SC 4940-97-CL-E03)	4940-00-287-4894	T10549

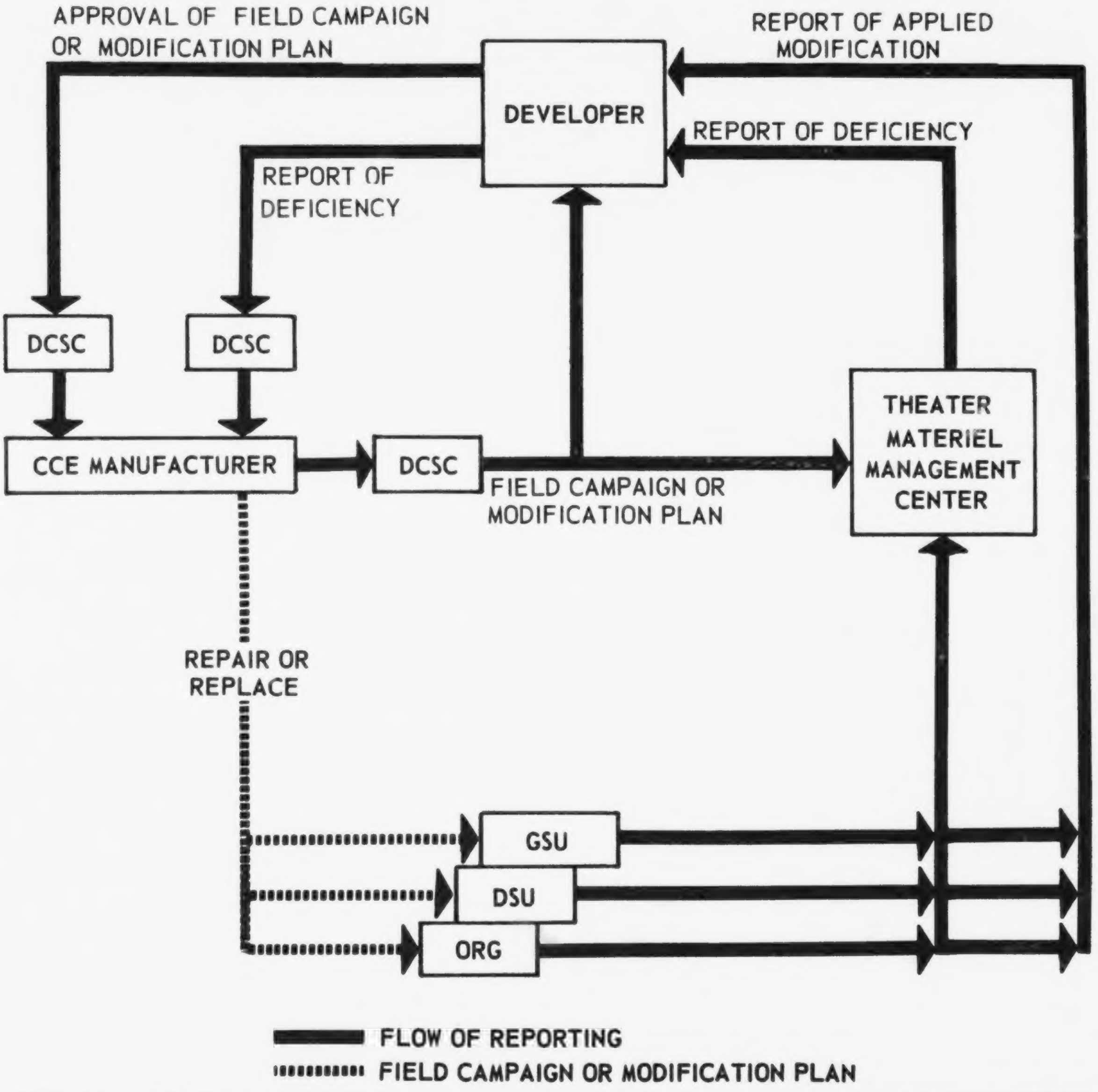
TOOL OR TEST EQUIPMENT REFERENCE CODE	MAINTENANCE CATEGORY	NOMENCLATURE	NATIONAL/NATO STOCK NUMBER	TOOL NUMBER
2	F, H	Tool Kit Automotive, Fuel and Elec Sys repair (SC-4910-95-CL-A50)	4910-00-754-0665	W32456
2	F,H	Wrench Set, Socket: 3/4" Drive HEX type	5130-00-351-5135	Y75239
2	F, H	Tool Kit, Master Mechanic: Equip Maint and Repair (SC 5180-90-CL-E05)	5180-00-699-5273	W45060
2	F, H	Shop Set, Fuel and Elec Sys: Field Maint, Basic, Less Power (SC 4910-95-CL-A01)	4910-00-754-0714	T30414
2	F, H	Shop Set, Fuel and Elec Sys: Field Maint, Suppl #2, Less Power (SC 4910-95-CL-A65)	4910-00-390-7775	T30688
2	F, H	Shop Equip, Machine Shop: Field Maint, Basic, Less Power (SC 3470-95-CL-A02)	3470-00-754-0708	T15644
2	F, H	Measuring and Layout Tool Set, Machinist's (SC 5280-95-CL-A02)	5280-00-511-1950	W4412
3	F, H	Pressure Checking Kit	4910-00-792-8304	3005456(24076)
4	F, H	Multimeter AN/USM-223	6625-00-999-7465	M80242
5	F, H	Test SEt, Diesel Injoctor (SC 4910-IL)	4910-00-317-8265	V73742
6	F, H	Wrench, Torque: 2500 lb ft, Model PD 2501	4120-00-482-2543	Y81747

SECTION IV. REMARKS

REFERENCE CODE	REMARKS
A	No repair authorized.
B	Includes repair by kit.
C	Window repair kit.

APPENDIX D

CCE MANUFACTURER FIELD CAMPAIGNS AND MODIFICATION PROCEDURES


APPROVAL OF FIELD CAMPAIGN OR MODIFICATION PLAN
REPORT OF APPLIED MODIFICATION
DEVELOPER
REPORT OF DEFICIENCY
REPORT OF DEFICIENCY
DCSC
DCSC
THEATER MATERIEL MANAGEMENT CENTER
CCE MANUFACTURER
DCSC
FIELD CAMPAIGN OR MODIFICATION PLAN
REPAIR OR REPLACE
GSU
DSU
ORG
FLOW OF REPORTING
FIELD CAMPAIGN OR MODIFICATION PLAN

TA 162338

APPENDIX E

BASIC ISSUE ITEM LIST (CCE)

MFG Stock Number	Description	Unit of Issue	Quantity Incorporated In Unit Pack	Quantity with Furnished Unit
7510-00-889-3494	Note: The following items are overpacked with the equipment.			
	Binder, Loose Leaf: U. S. Army Equipment Log Book	each	1	1
7520-00-559-9618	Case: Maintenance and Operational Manuals, Cotton Duck, Water Repellant, Mildew-Resistant, MIL-B-11743B	each	1	1
	Service Manual (REG01703)	each	2	2
	Parts Manual, Power Shift, Tractor (SEBP1111)	each	2	2
	Serivce Manual, Winch (REGO 1102-02)	each	2	2
	Parts Manual, Dozers (SEBP1000)	each	2	2
	Parts Manual, Ripper Item 2 (UEG0135S)	each	2	2
	Parts Manual. Hydraulic Control (UEG0902S)	each	2	2
	Parts Manual, Winch Item 1 (UEG0602S)	each	2	2
	Operating Manual, Tractor and Attachments (SEBU5202)	each	2	2
	Lubrication & Maintenance Manual, Tractor and Attachments (SEBU5200)	each	2	2

MFG Stock Number	Description	Unit of Issue	Quantity Incorporated In Unit Pack	Quantity with Furnished Unit
	Installation - 8S Dozer (GMG02607)	each	2	2
	Installation - 58 & 59 Winches (GEG02234)	each	2	2
	Installation - 8A Bulldozer (FM033261)	each	2	2
	Installation - 8D Ripper (GMG02592)	each	2	2
	Tractor Safety Manual (SEBU5311)	each	2	2
9905-00-565-6267	Kit, Sign	each	1	1

APPENDIX F

MAINTENANCE AND OPERATING SUPPLY LIST (CCE)

NOMENCLATURE: TRACTOR, FULL-TRACKED, LOW SPEED, HEAVY DRAWBAR PULL	**MAKE:** CATERPILLAR TRACTOR COMPANY		**MODEL:** D8K8A-58 D8K8S-8
MFR PART NO:	**NSN:** 2410-00-574-7597 2410-00-574-7598	**SERIAL NO. RANGE:** ——— TO ———	**DATE:**

(1) COMPONENT APPLICATION	(2) MFR PART NO. OR NAT'L STOCK NO.	(3) DESCRIPTION		(4) QTY REQ F/INITIAL OPN	(5) QTY REQ F/8 HRS OPN	(6) NOTES
0100 ENGINE		Oil, Lubricating				(1) See Lube and Maintenance Guide for change intervals and Grade Application
	9150-00-188-9858	OE/HDO 30	(1)	8.75 gal	AR	
	9150-00-186-6668	OE/HDO 10 (MIL-L-2104C)	(1)	8.75 gal	AR	
	9150-00-402-2372	OEA Arctic (MIL-L-46167)	(1)	8.75 gal	AR	
0300 FUEL SYSTEM		Diesel Fuel Oil			(2)	(2) Estimated consumption at medium load factor. (8.1 gal to 13.5 gal per hr)
	9140-00-286-5296	Diesel DF-2	(3)	175 gal	86 gal	(3) Regular grade
	9140-00-286-5286	Diesel DF-1	(4)	175 gal	86 gal	(4) Winter grade
	9140-00-286-5282	Diesel DF-A	(5)	175 gal	86 gal	(5) Artic grade
0801 FINAL DRIVES		Oil Lubricating				
	9150-00-188-9864	OE/HDO 50	(1)	9.5 gal	AR	
	9150-00-188-9858	OE/HDO 30	(1)	9.5 gal	AR	

NOMENCLATURE: TRACTOR, FULL-TRACKED, LOW SPEED, HEAVY DRAWBAR PULL		**MAKE:** CATERPILLAR TRACOR COMPANY	**MODEL:** D8K8A-58 K8K8S-8
MFR PART NO:	**NSN:** 2410-00-574-7597 2410-00-574-7598	**SERIAL NO. RANGE:** ——— TO ———	**DATE:**

(1) COMPONENT APPLICATION	(2) MFR PART NO. OR NAT'L STOCK NO.	(3) DESCRIPTION	(4) QTY REQ F/INITIAL OPN	(5) QTY REQ F/8 HRS OPN	(6) NOTES
2001 WINCH	9150-00-188-9858 9150-00-186-6668	Oil Lubricating OE/HDO 30 (1) OE/HDO 10 (1)	17 gal 17 gal	AR AR	
2400 HYDRAULIC SYSTEM	9150-00-191-2772	Oil Lubricating OE/HDO 10 (1)	31 gal	AR	
.0500 COOLING SYSTEM	6850-00-181-7933	Coolant Antifreeze (6) (MIL-A-46153)	32 gal AR	AR AR	(6) For protection against freezing in ambient temperatures as low as -55°F when diluted to 60% by vol with water.
0710 TRANSMISSION, BEVEL GEAR, & STEERING CLUTCH COMPARTMENT	9150-00-188-9858 9150-00-186-6668	Oil Lubricating (7) OE/HDO 30 (1) OE/HDO 10 (1) (MIL-L-2104C)	31 gal 31 gal	AR AR	(7) Quantity of oil in transmission may be increased by 10% when operating on severe slopes.

NOMENCLATURE: TRACTOR, FULL-TRACKED, LOW SPEED, HEAVY DRAWBAR PULL
MAKE: CATERPILLAR TRACTOR COMPANY
MODEL: D8K8A-58 D8K8S-8
MFR PART NO:
NSN: 2410-00-574-7597 2410-00-574-7598
SERIAL NO. RANGE: ——— TO ———
DATE:

(1) COMPONENT APPLICATION	(2) MFR PART NO. OR NAT'L STOCK NO.	(3) DESCRIPTION	(4) QTY REQ F/INITIAL OPN	(5) QTY REQ F/8 HRS OPN	(6) NOTES
LUBE POINTS	9150-00-402-2372	OEA Artic (1) (MIL-L-46167)	31 gal	AR	
		Grease, Automotive GAA (MIL-G-10924C)			
	9150-00-190-0904	1-lb can			
	9150-00-190-0905	5-lb can			
	9150-00-190-0907	35-lb can			
CLEANING		Solvent, Dry Cleaning, SD-2 (P-D680)			
	6850-00-664-5685	1-qt can			
	6850-00-281-1985	1-gal can			
	6850-00-264-9038	5-gal drum			
	6850-00-285-8012	55-gal drum			

APPENDIX G

SAMPLE FORMAT

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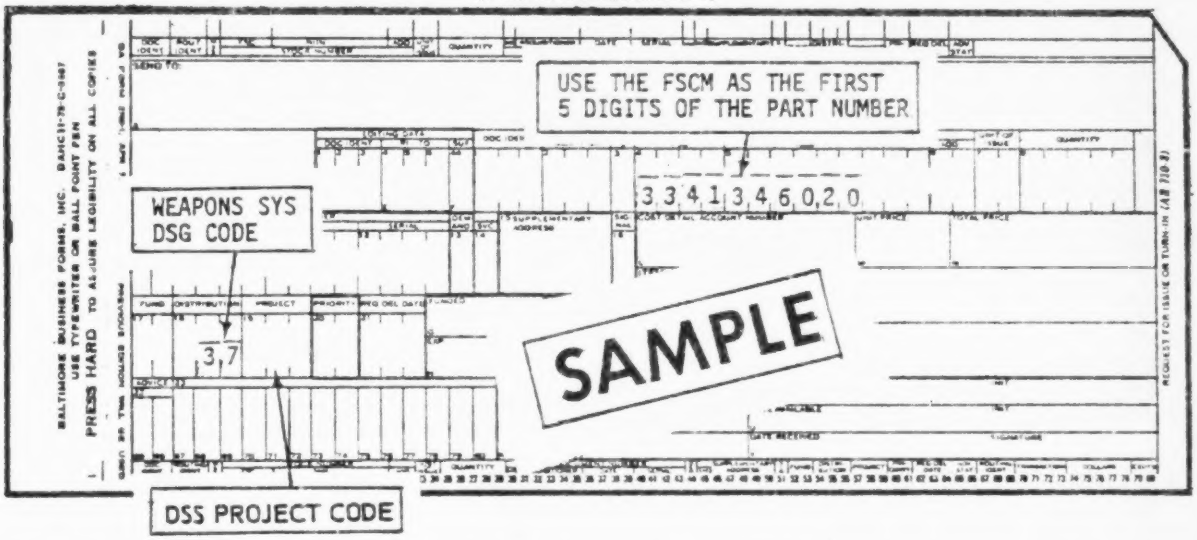
DA FORM 2765 PART NUMBER REQUEST

(CONUS REQUESTOR)



USE THE FSCM AS THE FIRST 5 DIGITS OF THE PART NUMBER

3341346020

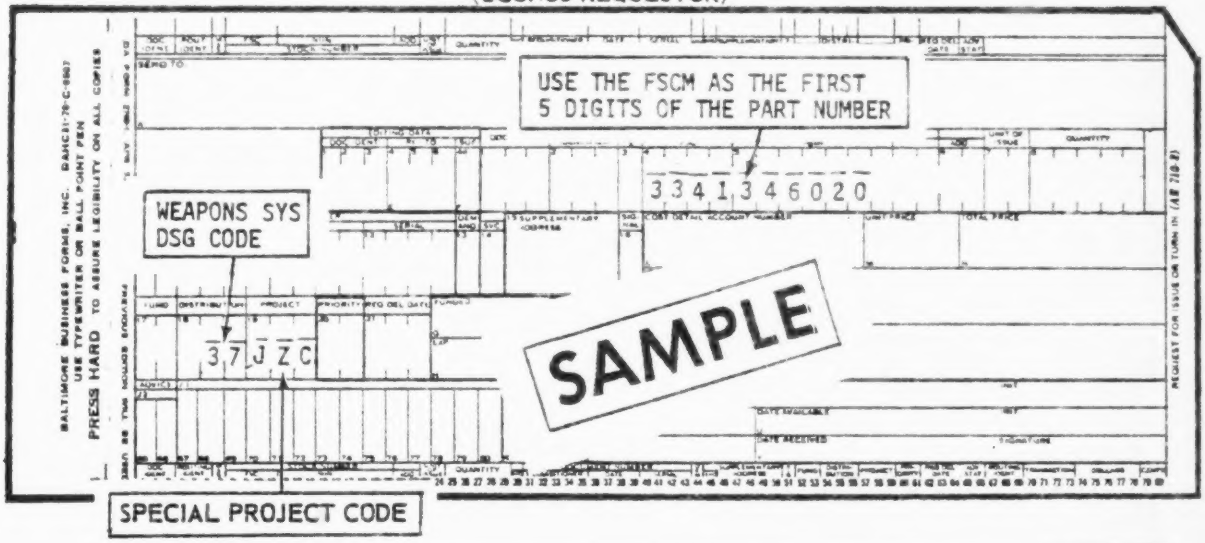
WEAPONS SYS DSG CODE

37

DSS PROJECT CODE

SAMPLE

(OCONUS REQUESTOR)



USE THE FSCM AS THE FIRST 5 DIGITS OF THE PART NUMBER

3341346020

WEAPONS SYS DSG CODE

37JZC

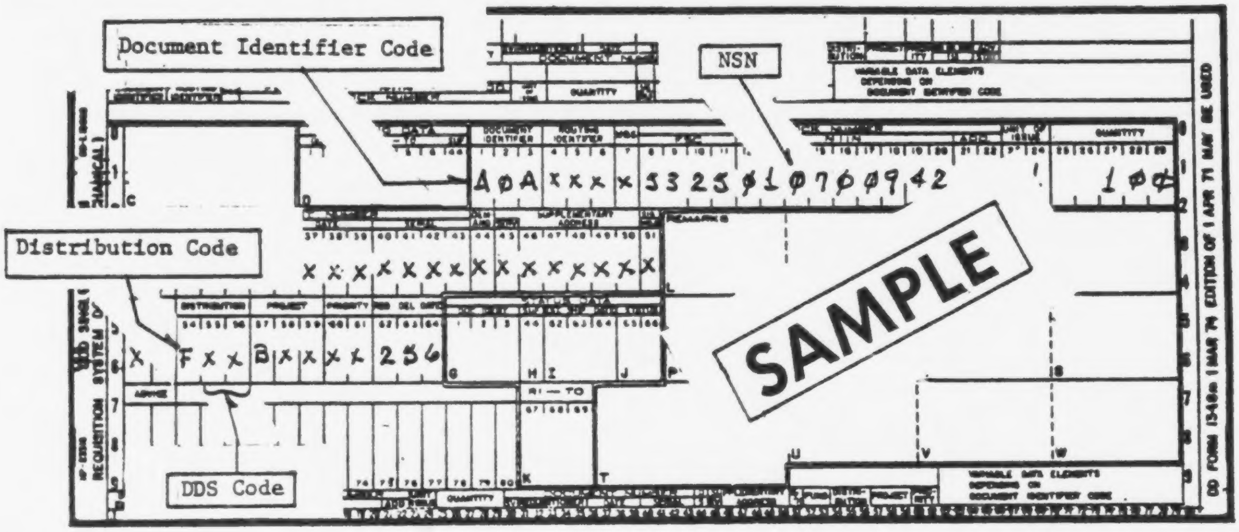
SPECIAL PROJECT CODE

SAMPLE

TA 126340

APPENDIX H

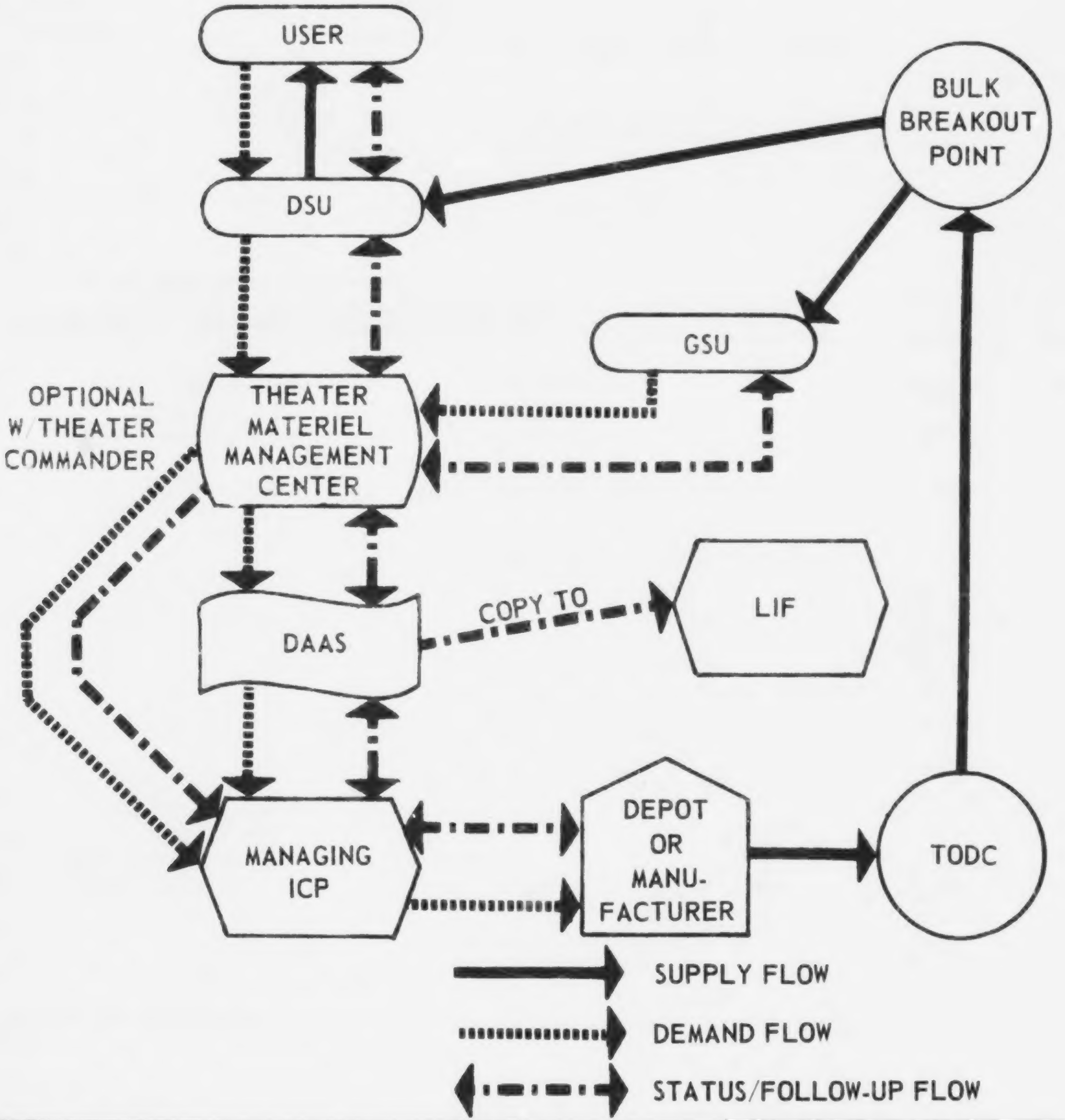
SAMPLE FORMAT - MILSTRIP REQUISITION FOR CCE (NSN)


Document Identifier Code
NSN
Distribution Code
DDS Code
AØA xxxx 5325Ø1Ø7ØØ942
1ØØ
xxxxxxxxxxxxxx
X F x x B x x x x 256
SAMPLE

CARD COLUMN	DESCRIPTION OF DATA	MANDATORY ENTRY FOR CCE
1-3	Document Identifier Code	AØA - CONUS AØ1 - Overseas
4-6	Routing Identifier Code	
7	Media/Status Code	
8-22	NSN	
23-24	Unit of Issue	
25-29	Quantity	
30-43	Document Number	
44	Demand Code	
45-50	Supplementary Address	
51	Signal Code	
52-53	Fund Code	
54-56	Distribution Code CC-54	"F" for CONUS; see AR 725-50 for OCONUS
	CC-55-56	Weapon System Code (DSS) Code
57-59	Project Code	
60-61	Priority Code	
62-64	Required Delivery Date	
65-66	Advice Code	

TA 126334

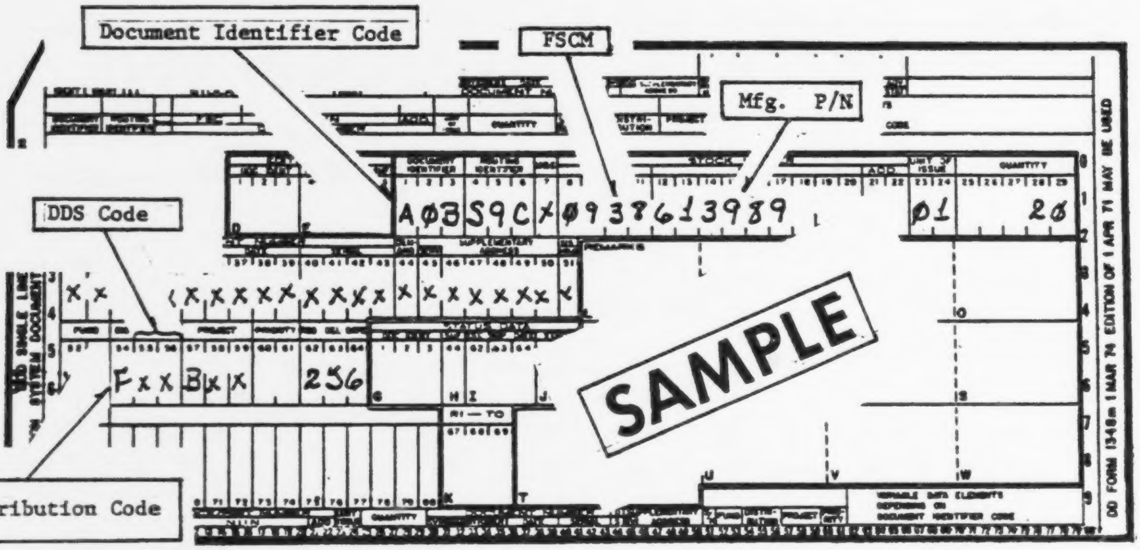
FLOW OF REQUISITIONS AND MATERIEL CCE PARTS (NSN)


USER
DSU
BULK BREAKOUT POINT
GSU
OPTIONAL W/THEATER COMMANDER
THEATER MATERIEL MANAGEMENT CENTER
DAAS
COPY TO
LIF
MANAGING ICP
DEPOT OR MANU-FACTURER
TODC
SUPPLY FLOW
DEMAND FLOW
STATUS/FOLLOW-UP FLOW

TA 126332

APPENDIX I

SAMPLE FORMAT - MILSTRIP REQUISITION FOR CCE (NON-NSN)


Document Identifier Code
FSCM
Mfg. P/N
DDS Code
Distribution Code
SAMPLE
DD FORM 1348m 1 MAR 74 EDITION OF 1 APR 71 MAY BE USED

A0B S9C X 09 38613989 01 20

X X XXXXXXXXXXXXXXXXX

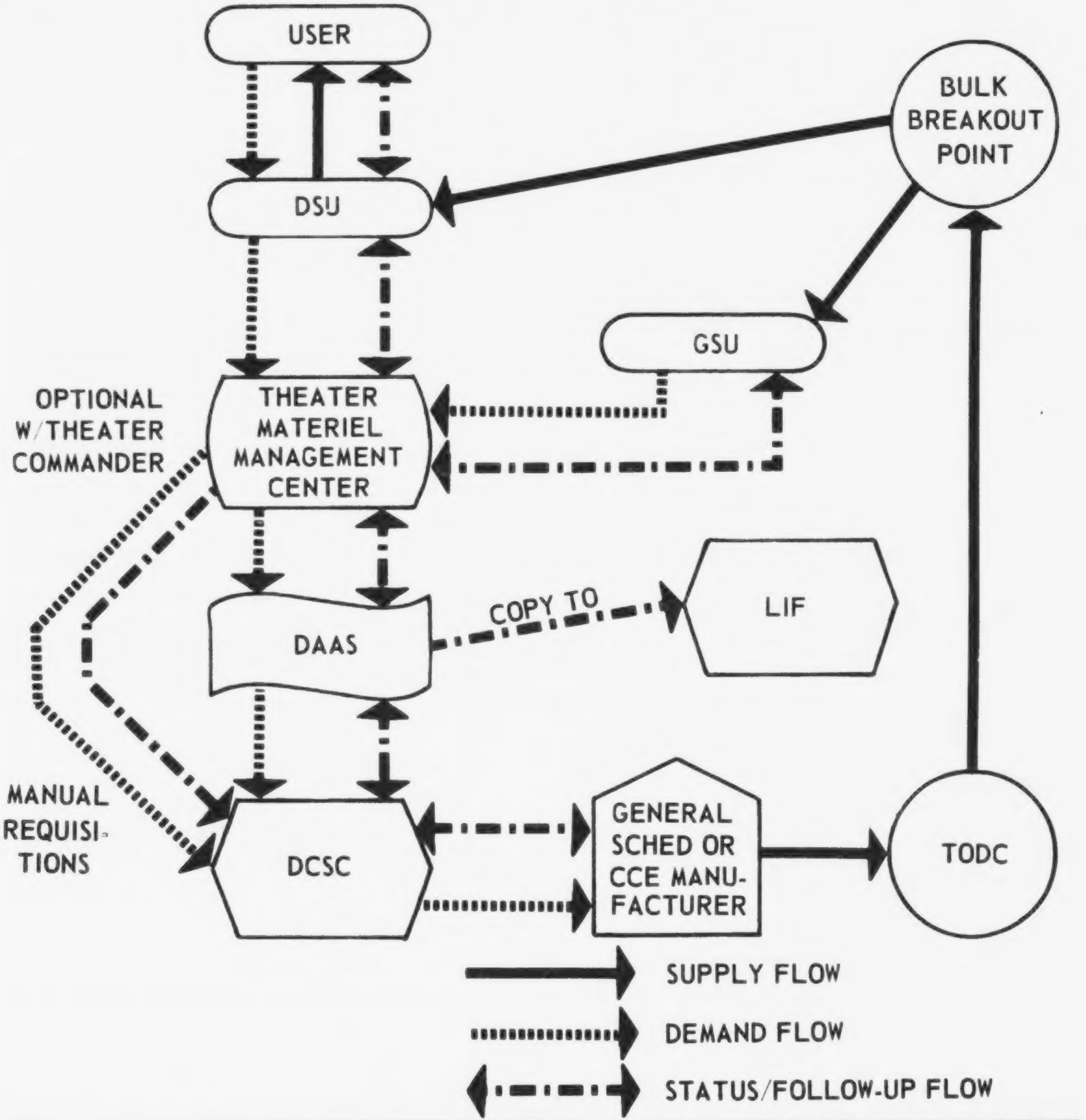
F x x B x x 256

CARD COLUMN	DESCRIPTION OF DATA	MANDATORY ENTRY FOR CCE
1-3	Document Identifier Code	A0B - CONUS A02 - Overseas
4-6	Routing Identifier Code	Always S9C
7	Media/Status Code	
8-22	FSCM and Part Number	
23-24	Unit of Issue	
25-29	Quantity	
30-43	Document Number	
44	Demand Code	
45-50	Supplementary Address	
51	Signal Code	
52-53	Fund Code	
54-56	Distribution Code CC-54	"F" for CONUS; see AR 725-50 for OCONUS
	CC-55-56	Weapon System Code CCE (DSS) Code
57-59	Project Code	
60-61	Priority Code	
62-64	Required Delivery Date	
65-66	Advice Code	

TA 1126335

CARD COLUMN	BLOCK	DESCRIPTION OF DATA	MANDATORY ENTRY FOR CCE
67-69	23	Blank	
70	23	Identification code applicable to entry in cc 71-80. A - Technical order or Technical Manual. B - End Item Identification C - Noun Description D - Drawing or Specification No.	
71-80	23	Reference Identification	Identification of reference specified in cc 70

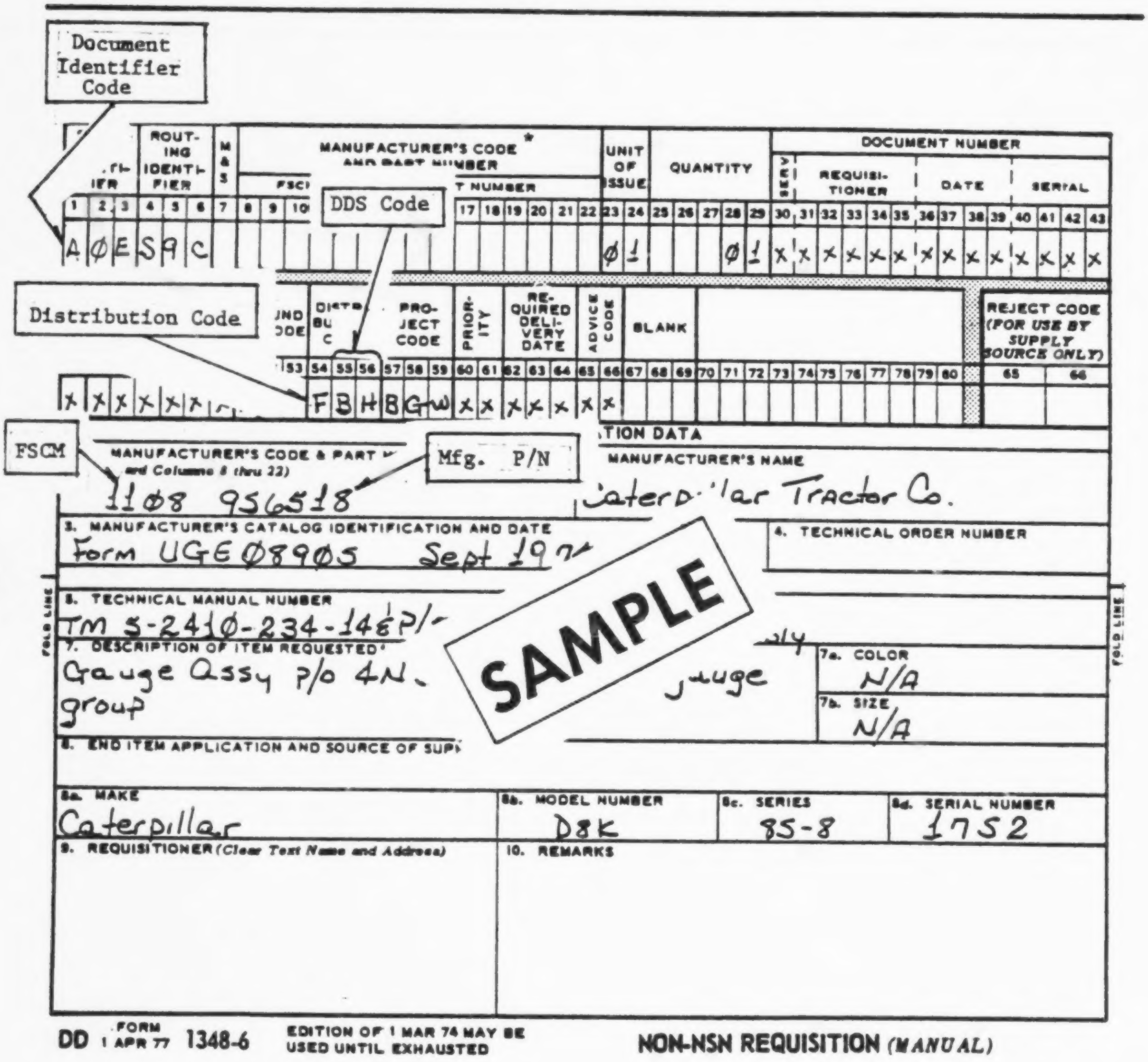
FLOW OF REQUISITIONS AND MATERIEL CCE PARTS (NON-NSN)


USER
BULK BREAKOUT POINT
DSU
GSU
OPTIONAL W/THEATER COMMANDER
THEATER MATERIEL MANAGEMENT CENTER
COPY TO
LIF
DAAS
MANUAL REQUISITIONS
DCSC
GENERAL SCHED OR CCE MANUFACTURER
TODC
SUPPLY FLOW
DEMAND FLOW
STATUS/FOLLOW-UP FLOW

TA 126333

APPENDIX J

SAMPLE FORMAT - MILSTRIP REQUISITION FOR CCE (NON-NSN) (MANUAL)


Document Identifier Code
DDS Code
Distribution Code
FSCM
Mfg. P/N

ROUTING IDENTIFIER · M & S · MANUFACTURER'S CODE AND PART NUMBER * · FSCM · PART NUMBER · UNIT OF ISSUE · QUANTITY · DOCUMENT NUMBER: SERV · REQUISITIONER · DATE · SERIAL

Card columns 1–43: A Ø E S A C · Ø 1 · Ø 1 · X X X X X X X X X X X X X X

FUND CODE · DISTRIBUTION CODE · PROJECT CODE · PRIORITY · REQUIRED DELIVERY DATE · ADVICE CODE · BLANK · REJECT CODE (FOR USE BY SUPPLY SOURCE ONLY) 65 66

Card columns 44–80: X X X X X X · F B H · B G W · X X · X X X · X X

IDENTIFICATION DATA

MANUFACTURER'S CODE & PART NUMBER (and Columns 8 thru 22): 11Ø8 956518

MANUFACTURER'S NAME: Caterpillar Tractor Co.

3. MANUFACTURER'S CATALOG IDENTIFICATION AND DATE: Form UGEØ89ØS Sept 197

4. TECHNICAL ORDER NUMBER:

5. TECHNICAL MANUAL NUMBER: TM 5-241Ø-234-14&P/1

7. DESCRIPTION OF ITEM REQUESTED: Gauge Assy P/o 4N- group ... ly ... Gauge

7a. COLOR: N/A

7b. SIZE: N/A

8. END ITEM APPLICATION AND SOURCE OF SUPPLY

8a. MAKE: Caterpillar

8b. MODEL NUMBER: D8K

8c. SERIES: 85-8

8d. SERIAL NUMBER: 1752

9. REQUISITIONER (Clear Text Name and Address)

10. REMARKS

FOLD LINE

SAMPLE

DD FORM 1 APR 77 1348-6 · EDITION OF 1 MAR 74 MAY BE USED UNTIL EXHAUSTED · NON-NSN REQUISITION (MANUAL)

TA 126336

INSTRUCTIONS

This form will only be used in those cases where the manufacturer's code and part number exceed the spaces allocated in card columns 8 - 22 of the requisition.

CARD COLUMN	DESCRIPTION DATA	MANDATORY ENTRY FOR CCE
1 - 3	Document Identifier Code	AOE - CONUS A05 - OCONUS
4 - 6	Routing Identifier Code	Always S9C
7	Media Status Code	
8 - 22	FSCM and Part Number	Leave blank. Enter in Block 1 under Identification Data.
23 - 24	Unit of Issue	
25 - 29	Quantity	
30 - 43	Document Number	
44	Demand Code	
45 - 50	Supplementary Address	
51	Signal Code	
52 - 53	Fund Code	
54 - 56	Distribution Code cc 54	"F" for CONUS. (See AR 725-50 for OCONUS).
	*cc 55-56	Weapon System Code
57 - 59	Project Code	
60 - 61	Priority Code	
62 - 66	Advice Code	
67 - 80		Blank

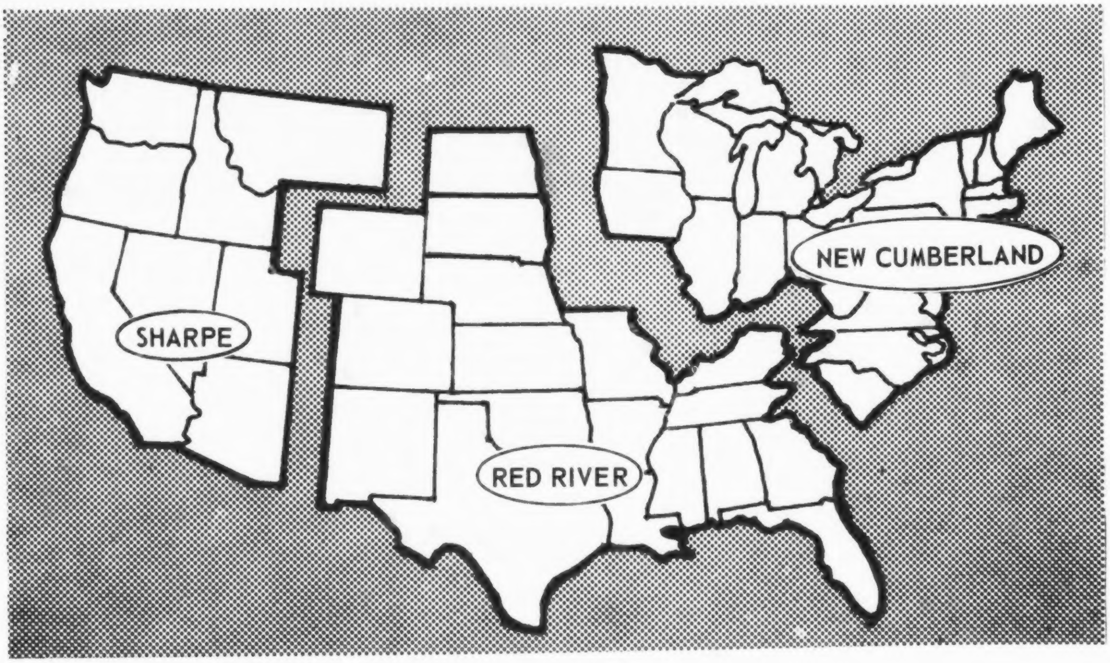
IDENTIFICATION DATA - Lower half of DD Form 1348-6, complete Blocks 1 thru 9.

APPENDIX K

DSS PROJECT CODES

Geographic Location	ASL	NSL
CONUS (Eastern US)	XDC	NSC *
CONUS (Central US)	XDA	NSA *
CONUS (Western US)	XDB	NSB *

Designated Distribution Depot Support Areas.



* NOTE:

DSS Project Codes NSA, NSB, and NSC have been cancelled and are no longer authorized for use.

TA 126339

APPENDIX L
PRESCRIBED LOAD LIST (PLL) AUTHORIZED STOCKAGE LIST (ASL)

End Item: Tractor, Full Tracked Size T-11	Make: Caterpillar	Model: D8K-8A-58 D8K-8S-8	
Mfr. Part No:	NSN: 2410-00-574-7597 2410-00-574-7598	Serial Number Range 77V1139 To Up	Date

SMR Code	National Stock Number	Part Number	FSCM	Part Description	Est. Price	U/M	Qty. of Parts Req'd for No. of End Items			
							PLL	ASL		
							1-5	1-5	6-20	21-50
PAOZZ	5420-00-927-9295	P10-0128 7M1674	18265 11083	Element, Filter (Air)	.22	Ea	2	6	8	10
PAOZZ	2940-01-018-4872	P11-9167 1P7716	18265 11083	Element, Filter (Pri)	7.37	Ea	2	6	8	10
PAOZZ	2940-01-018-4873	P11-9168 1P7360	18265 11083	Element, Filter (sec)	12.30	Ea	2	6	8	10
PAOZZ	2940-00-894-6406	P15467 6H6095	18265 11083	Element, Filter (Oil, Brthr)	2.48	Ea	1	2	4	6
PAOZZ	3830-01-047-9395	9J750	11083	Element, Filter (Hyd Tank)	6.71	Ea	•	•	1	2
PAOZZ	2910-00-157-0650	1P2299 238500	11083 73370	Filter Assy, Fuel	1.57	Ea	2	6	10	10
PAOZZ	2920-00-932-0829	1P7324	11083	Glow Plug	12.81	Ea	6	6	12	24
PAOZZ	2910-00-989-3388	9M2341	11083	Element Filter (Pri Fuel)	1.69	Ea	2	6	8	10
PAOZZ	6240-00-019-3093	623 2D1959	09172 11083	Lamp, Incandescent (Instr)	.53	Ea	1	4	6	6
PAFZZ	5330-00-194-8388	3S9300	11083	Gasket (Fuel Pump)	1.52	Ea	•	•	1	1
PAOZZ	5330-00-585-4284	8H2778	11083	Gasket (Pri Fuel Filter)	.55	Ea	•	•	1	1
PAOZZ	3030-01-017-8320	2S8268	11083	Belts, V, Matched Set	31.83	Set	1	1	2	2

End Item: Tractor, Full Tracked Size T-11	Make: Caterpillar	Model: D8K-8A-58 D8K-8S-8	
Mfr. Part No:	NSN: 2410-00-574-7597 2410-00-574-7598	Serial Number Range 77V1139 To Up	Date

SMR Code	National Stock Number	Part Number	FSCM	Part Description	Est. Price	U/M	Qty. of Parts Req'd for No. of End Items			
							PLL	ASL		
							1-5	1-5	6-20	21-50
PAOZZ	4330-00-168-1861	4J6064	11083	Element, Filter (XMSN)	2.83	Ea	2	6	8	10
PAOZZ	6240-00-643-0687	5949701	73331	Lamp, Incandescent	2.41	Ea	1	2	4	8
		1M5898	11083	(Flood)						
PAOZZ	2910-00-355-6377	9F739	11083	Cartridge, Engine Starter	.20	Ea	2	4	6	8
PAOZZ	2940-00-125-9545	6686685	81321	Filter Assy (Eng Oil)	7.12	Ea	1	8	12	20
		2P4005	11083							
PAOZZ	2940-00-192-7417	7S687	11083	Indicator, Air Filter	4.32	Ea	1	2	4	6

APPENDIX M
PREVENTIVE MAINTENANCE CHECKS AND SERVICES

M-1. Maintenance Forms and Records

Every mission begins and ends with the paperwork. There isn't much of it, but you have to keep it up. The forms and records you fill out have several uses. They are a permanent record of the services, repairs, and modifications made on your vehicle. They are reports to organizational maintenance and to your commander. They are a checklist for you when you want to know what is wrong with the vehicle after its last use, and whether those faults have been fixed. For the information you need on forms and records, see TM 38-750.

M-2. Preventive Maintenance Checks and Services

a. Do your before (B) PREVENTIVE MAINTENANCE just before you operate the vehicle. Pay attention to the CAUTIONS and WARNINGS.

b. DURING checks and services, (D) of PREVENTIVE MAINTENANCE will be performed while the equipment and/or its component systems are in operation.

c. Do your after (A) PREVENTIVE MAINTENANCE right after operating the vehicle. Pay attention to the CAUTIONS and WARNINGS.

d. Do your weekly (W) PREVENTIVE MAINTENANCE weekly.

e. Do your monthly (M) PREVENTIVE MAINTENANCE once a month.

f. If something doesn't work, troubleshoot it with the instructions in this manual or notify your supervisor.

g. Always do your PREVENTIVE MAINTENANCE in the same order so it gets to be a habit. Once you've had some practice, you'll spot anything wrong in a hurry.

h. If anything looks wrong and you can't fix it, write it on your DA Form 2404. If you find something seriously wrong, report it to organizational maintenance RIGHT NOW.

i. When you do your PREVENTIVE MAINTENANCE, take along the tools you need to make all the checks. You always need a rag or two.

(1) Keep it clean: Dirt, grease, oil, and debris only get in the way and may cover up a serious problem. Clean as you work and as needed. Use dry cleaning solvent (SD-2) on all metal surfaces. Use soap and water when you clean rubber or plastic material.

WARNING

Dry cleaning solvent, used to clean parts is potentially dangerous to personnel and property. Do not use near open flame or excessive heat. Flash point of solvent is 138° F.

(2) Bolts, nuts, and screws: Check them all for obvious looseness, missing, bent or broken condition. You can't try them with a tool, of course, but look for chipped paint, bare metal, or rust around bolt heads. If you find one you think is loose, tighten it, or report it to organizational maintenance if you can't tighten it.

(3) Welds: Look for loose or chipped paint, rust, or gaps where parts are welded together. If you find a bad weld, report it to organizational maintenance.

(4) Electric wires and connectors: Look for cracked or broken insulation, bare wires, and loose or broken connectors. Tighten loose connectors and make sure the wires are in good shape.

(5) Hoses and fluid lines: Look for wear, damage, and leaks, and make sure clamps and fittings are tight. Wet spots show leaks, of course. But a stain around a fitting or connector can mean a leak. If a leak comes from a loose fitting or connector, tighten it. If something is broken or worn out, report it to organizational maintenance.

j. It is necessary for you to know how fluid leakage affects the status of your vehicle. The following are definitions of the types/classes of leakage an operator or crew member needs to know to be able to determine the status of his/her vehicle. Learn, then be familiar with them and REMEMBER—WHEN IN DOUBT, NOTIFY YOUR SUPERVISOR!

Leakage Definitions for Crew/Operator PMCS

Class I	Seepage of fluid (as indicated by wetness or discoloration) not great enough to form drops.
Class II	Leakage of fluid great enough to form drops but not enough to cause drops to drip from item being checked/inspected.
Class III	Leakage of fluid great enough to form drops that fall from the item being checked/inspected.

CAUTION

EQUIPMENT OPERATION IS ALLOWABLE WITH MINOR LEAKAGE (CLASS I OR II). OF COURSE, CONSIDERATION MUST BE GIVEN TO THE FLUID CAPACITY IN THE ITEM/SYSTEM BEING CHECKED/INSPECTED. WHEN IN DOUBT, NOTIFY YOUR SUPERVISOR.

NOTE

When tightening pipe or straight thread O-Ring connections, always use two wrenches to prevent bending or breaking tubing. When tightening U-bolt flange connections, tighten all bolts equally to prevent flange from cocking. IMPORTANT: Do not overtighten.

Operator/Crew Preventive Maintenance Checks and Services

B-Before D-During A-After W-Weekly M-Monthly

NOTE

Within designated interval, these checks are to be performed in the order listed.

Item No.	Interval					Procedure: Check for and have repaired, filled or adjusted as needed	Equipment Is Not Ready/Available If:
	B	D	A	W	M		
						PERFORM WEEKLY AS WELL AS BEFORE PMC'S IF	
						a. You are the assigned driver but have not operated tractor since the last weekly.	
						b. You are operating the tractor for the first time.	
1						MAKE THE FOLLOWING WALK AROUND CHECKS BEFORE MOUNTING THE MACHINE TO START THE ENGINE:	
	X					*a.* ENGINE COMPARTMENT. Check for oil and fuel leaks.	Class III leakage is evident, no fuel leakage allowed.
	X					*b.* COOLING SYSTEM. Check for leaks, worn hoses and trash build-up around radiator.	Class III leakage is evident.
	X					*c.* EQUALIZER BAR SUPPORT PIN. Check for leaks.	Class III leakage is evident.
	X					*d.* TRACK. Check for broken or missing shoes, bolts and nuts.	
	X					*e.* HYDRAULIC SYSTEM. Check for leaks, worn hoses and damaged lines.	Class III leakage is evident.
	X					*f.* COVERS AND GUARDS. Check for damage, loose or missing bolts.	
	X					*g.* TRANSMISSION AND FINAL DRIVES. Check under tractor for leaks.	Class III leakage is evident.
	X					*h.* SPROCKETS. Check for wear.	
	X					*i.* ROLLERS AND IDLERS. Check for wear or leaks.	Class III leakage is evident.
	X					*j.* OPERATOR'S COMPARTMENT. Check for cleanliness.	
	X					*k.* ROLL-OVER PROTECTIVE STRUCTURE (ROPS). Check for damage or loose mounting.	Cracked welds, buckled or split seams, loose or missing mounting bolts or nuts.
2	X					ENGINE OIL LEVEL Oil level must be in SAFE STARTING RANGE on ENGINE STOPPED side of dipstick.	
3				X		RADIATOR Maintain coolant level within 1/2 in. (1 cm) of bottom of fill pipe.	
4	X					FUEL TANK *a.* Open fuel drain valve and drain off any water and sediment into a suitable container. *b.* Check diesel fuel level.	
5		X				AIR CLEANER SERVICE INDICATOR During engine warm-up/operation, check indicator for indication of air flow restriction. If red flag is visible, have air cleaner serviced.	
6	X					HYDRAULIC SYSTEM Check oil level, it should be visible in sight gauge.	
7	X					TRANSMISSION Tilt seat forward and check transmission oil level. Oil level must be between ADD and FULL marks on dipstick.	

Organizational Preventive Maintenance Checks and Services

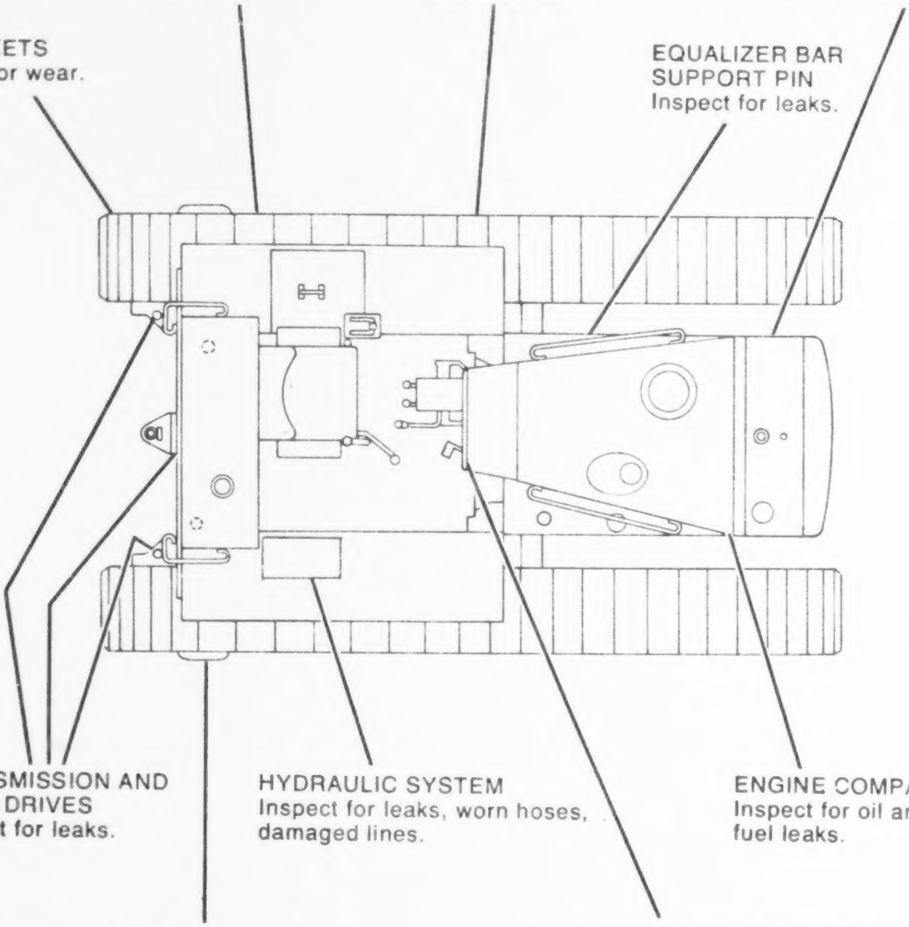
Q-Quarterly S-Semiannually A-Annually B-Biennially H-Hours M-Miles

	Interval						
Item No.	Q	S	A	B	H	MI	Procedure: Check for and have repaired, filled or adjusted as needed
					250		*ENGINE CRANKCASE* Operate engine long enough to warm the oil. Stop engine and open drain valve. Change oil filter and wash breather in clean nonflammable solvent. Fill crankcase with oil.
					250		*TRANSMISSION, BEVEL GEAR AND STEERING CLUTCH COMPARTMENTS* Change filter elements and wash magnetic strainer.
					250		*TRACK ADJUSTMENT* Adjust track tension if track SAG is less than or more than 1 to 1$^1/_2$ inches at a point midway between the front carrier roller and idler.
					250		*FAN AND ALTERNATOR BELTS* Check alternator belt deflection. Correct adjustment allows $^3/_4$ inch (19 mm) deflection at center distance between pulleys under 25 lb force (110 N). Fan belt tension is self-adjusting. Replace belts in sets only.
					500		*HYDRAULIC CONTROL SYSTEM* Change filter elements. Wash screen assembly in clean nonflammable solvent. Check oil level.
					500		*FUEL TANK CAP AND SCREEN* Wash filler cap and screen assembly in clean nonflammable solvent. Oil elements of cap assembly lightly.
					500		*WINCH* Change filter. Wash strainer and magnet assembly in clean nonflammable solvent.
					1000		*TRANSMISSION, TORQUE CONVERTER, BEVEL GEAR AND STEERING CLUTCH COMPARTMENTS* Change oil and breathers. Oil should be warm before draining. Change filter elements and wash magnetic strainers.
					1000		*FINAL DRIVES* Change oil, filter elements and breather. Replace seals if damaged.
					1000		*WINCH* Change oil and breather.
					1000		*UNIVERSAL JOINT* Slowly lubricate 2 fittings with a lever-type hand gun. Use of pressure type lubricating equipmen will cause the seals to be damaged.
					1000		*ROPS* Retighten all mounting bolts and nuts to a torque of 900±100 lb ft (1220±135N-M).
					2000		*HYDRAULIC CONTROL SYSTEM* Change oil and filter element. Wash fill cap strainer in clean nonflammable solvent.
					2000		*ENGINE VALVE ADJUSTMENT* Measure valve lash and adjust if necessary. Proper valve clearance, engine stopped, is .020 in. (0.51 mm) on exhaust valves and .016 in. (0.41 mm) on intake valves. If valve clearance is within ± .003 in. (0.08 mm) of the normal clearance given, adjustment is not required.
					2000		*COOLING SYSTEM* Open radiator drain valve and allow coolant to drain. Remove engine transmission oil cooler drain plug and allow coolant to drain. Close radiator drain valve. Install engine transmission oil cooler plug. To help avoid air locks, add coolant slowly, at 5 US gallons (19 litres) per minute or less, to within $^1/_2$ in. (1 cm) of bottom of fill cap.
			X				*FIRE EXTINGUISHER* Inspect fire extinguisher cylinder data plate to insure that a hydrostatic test has been performed within the past 12 years. Faulty extinguishers or those beyond the test time limit (12 years) shall be declared unserviceable and replaced.

APPENDIX N

WALK-AROUND INSPECTION

For maintenance and operator personnel safety, and maximum service life of the machine, make a thorough walk-around inspection when doing lubrication and maintenance work. Inspect under and around for such items as loose bolts, trash build-up, oil or coolant leaks.



ROLLERS
Inspect for wear or leaks.

TRACKS
Check for loose or broken bolts.

COOLING SYSTEM
Inspect for leaks, worn hoses, trash build-up.

SPROCKETS
Inspect for wear.

EQUALIZER BAR SUPPORT PIN
Inspect for leaks.

TRANSMISSION AND FINAL DRIVES
Inspect for leaks.

HYDRAULIC SYSTEM
Inspect for leaks, worn hoses, damaged lines.

ENGINE COMPARTMENT
Inspect for oil and fuel leaks.

COVERS AND GUARDS
Inspect for damage, loose or missing bolts.

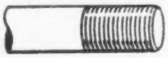
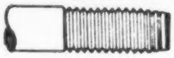
INDICATORS AND GAUGES
Inspect for damage.

APPENDIX O
SUPPLEMENTAL INFORMATION

BOLT, NUT AND TAPERLOCK STUD TORQUE

Caterpillar bolts, nuts and studs meet or exceed SAE Grade 8 requirements. The torque values given in the following tables are important and apply to bolts, nuts and studs meeting requirements of SAE Grade 8. Unless otherwise indicated in the Specifications, all bolts, nuts and taperlock studs should be tightened to the torque values in the following tables.

GENERAL TIGHTENING TORQUE

NOMINAL THREAD DIAMETER		TORQUE	
Standard thread 	Taperlock stud 		
inches	millimeters	lb. ft.	mkg
Bolts and Nuts			
¼	6,35	9±3	1,24±0,4
5/16	7,94	18±5	2,5±0,7
⅜	9,53	32±5	4,4±0,7
7/16	11,11	50±10	6,9±1,4
½	12,70	75±10	10,4±1,4
9/16	14,29	110±15	15,2±2,0
⅝	15,88	150±20	20,7±2,8
¾	19,05	265±35	36,6±4,8
⅞	22,23	420±60	58,1±8,3
1	25,40	640±80	88,5±11,1
1⅛	28,58	800±100	110,6±13,8
1¼	31,75	1000±120	138±16,6
1⅜	34,93	1200±150	166±20,7
1½	38,10	1500±200	207±27,7
Taperlock Studs			
¼	6,35	5±2	0,69±0,3
5/16	7,94	10±3	1,4±0,4
⅜	9,53	20±3	2,8±0,4
7/16	11,11	30±5	4,1±0,7
½	12,70	40±5	5,5±0,7
9/16	14,29	60±10	8,3±1,4
⅝	15,88	75±10	10,4±1,4
¾	19,05	110±15	15,2±2,0
⅞	22,23	170±20	23,5±2,8
1	25,40	260±30	35,9±4,1
1⅛	28,58	320±30	44,2±4,1
1¼	31,75	400±40	55±5,5
1⅜	34,93	480±40	66±5,5
1½	38,10	550±50	76±7
TORQUE APPLICABLE TO HYDRAULIC VALVE BODY BOLTS AND NUTS			
5/16	7,94	13±2	1,8±0,3
⅜	9,53	24±2	3,3±0,3
7/16	11,11	39±2	5,4±0,3
½	12,70	60±3	8,3±0,4
⅝	15,88	118±4	16,3±0,5

G.E.T. BOLT TORQUE

BOLT SIZE		RECOMMENDED TORQUE*	
inch	mm	lb ft	N·m
5/8	16	195 ± 25	265 ± 35
3/4	19	350 ± 50	475 ± 70
7/8	22	565 ± 85	765 ± 115
1	25	900 ± 110	1220 ± 150

*These values are applicable only to Caterpillar plow bolts.

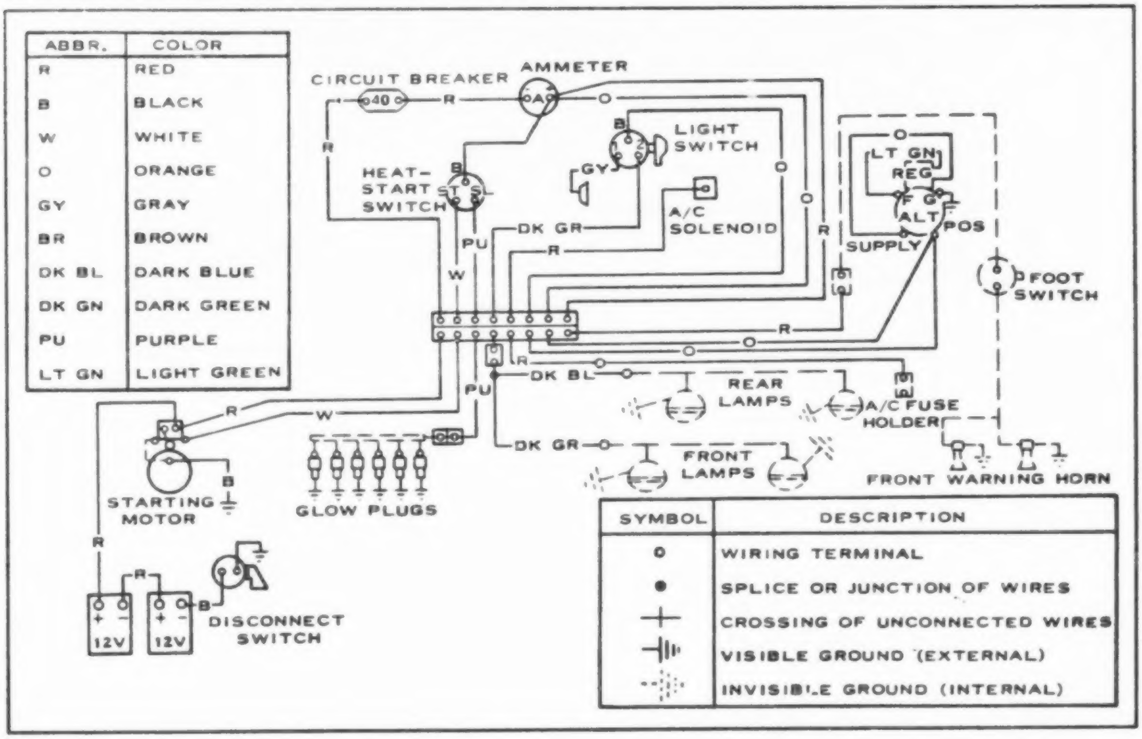
REFILL CAPACITIES (Approximate)

COMPARTMENT OR SYSTEM	U.S. MEASURE	METRIC MEASURE	IMPERIAL MEASURE
Diesel engine crankcase	8.75 gal.	33 ltr.	7.25 gal.
Transmission, bevel gear and steering clutch compartment⁽¹⁾	31 gal.	117 ltr.	25.75 gal.
Final drives (each)	9.50 gal.	36 ltr.	8 gal.
Cable control gear case	3.75 gal.	14 ltr.	3.25 gal.
Hydraulic system	35 gal.	132,5 ltr.	29.2 gal.
Cooling system	32 gal.	121,2 ltr.	26.7 gal.
Diesel fuel tank	170 gal.	643,5 ltr.	141.6 gal.
Winch oil sump⁽²⁾	17 gal.	64,3 ltr.	14.2 gal.

(1) Quantity of oil in transmission may be increased by 10% when operating on severe slopes.
(2) Use same type of oil as used in engine.

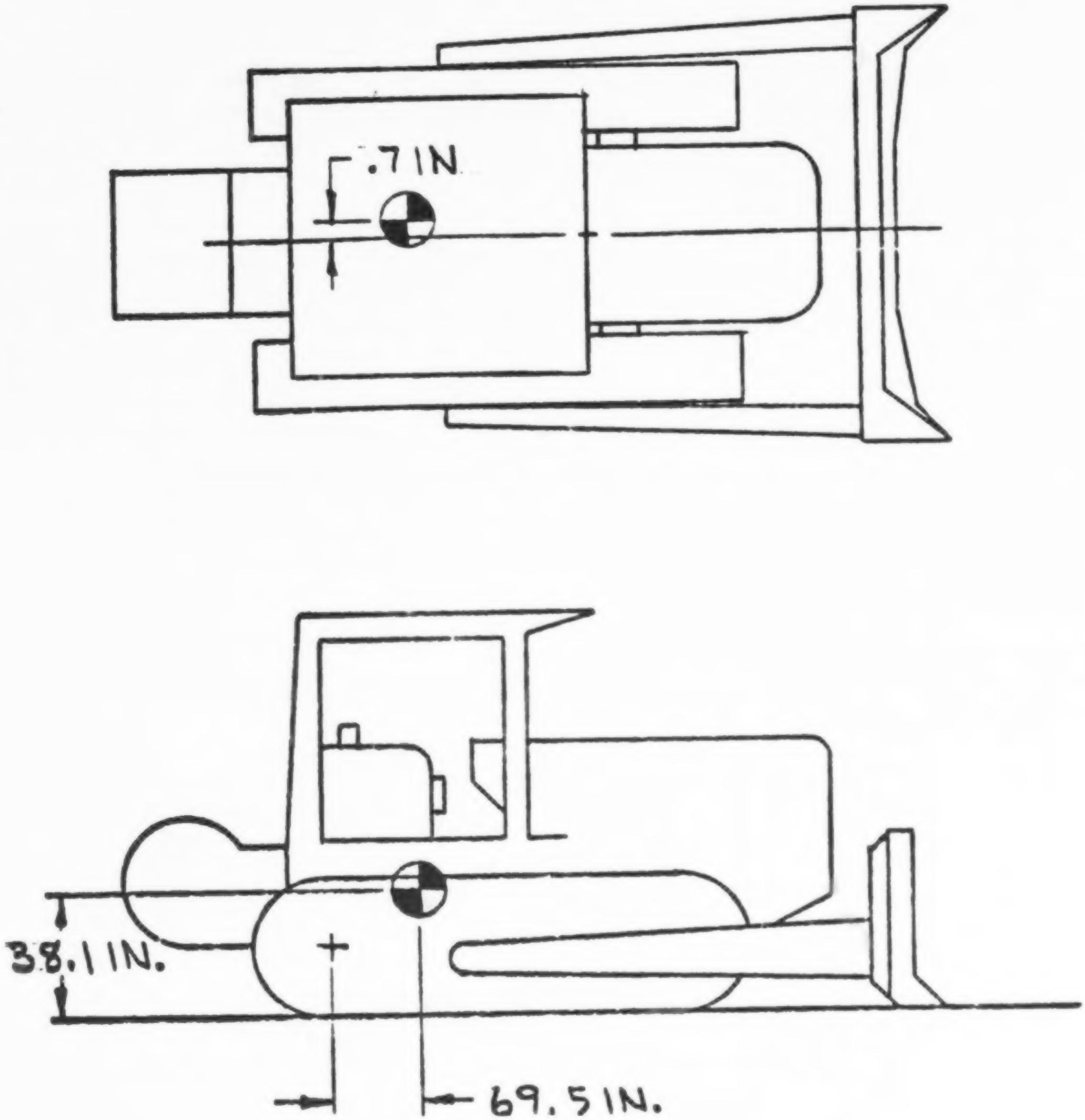
WIRING DIAGRAM

24 VOLT SYSTEM WITH ALTERNATOR

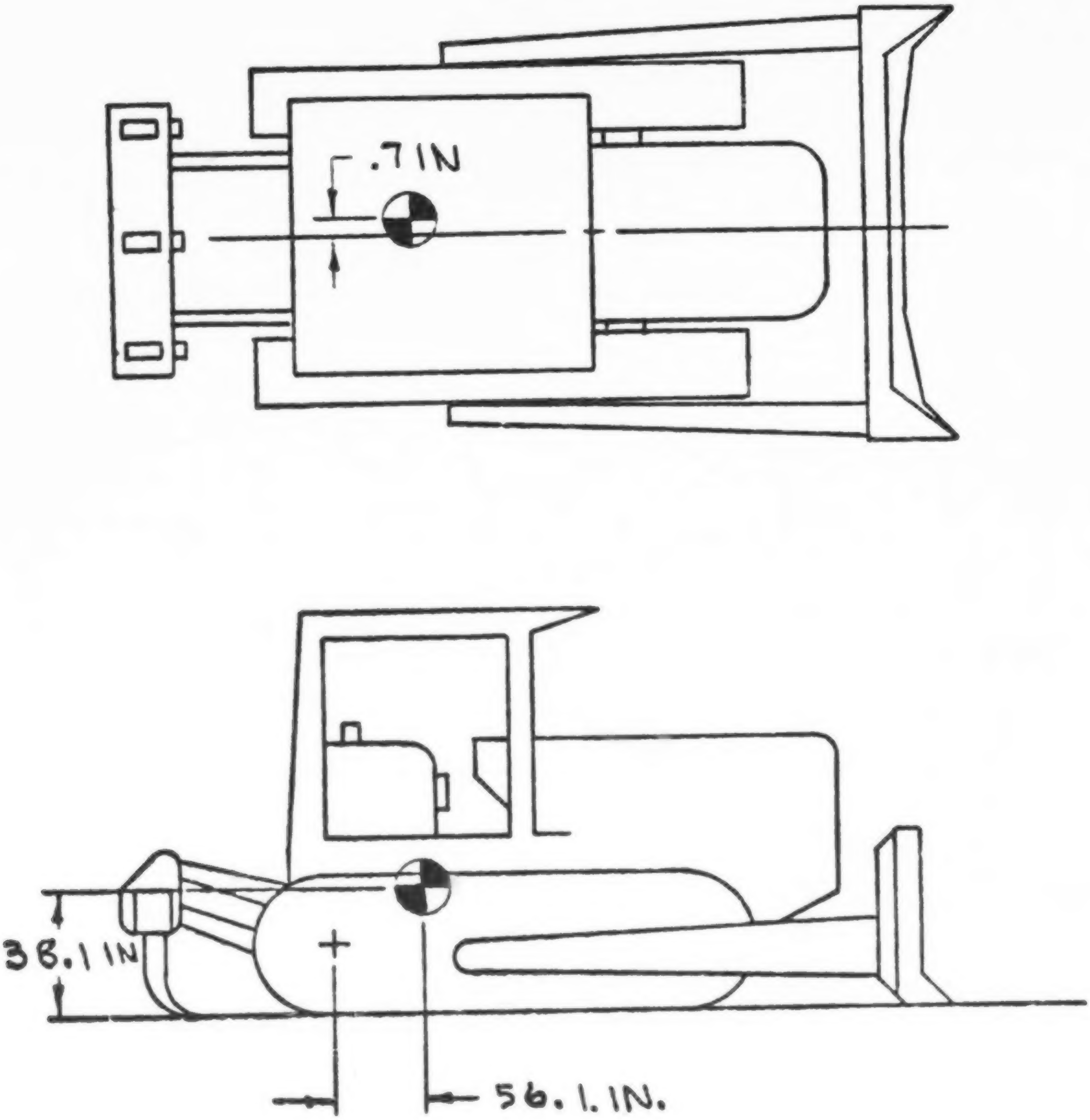

CIRCUIT BREAKER
40
AMMETER
A
LIGHT SWITCH
B
GY
HEAT-START SWITCH
ST
S
PU
W
DK GR
A/C SOLENOID
R
O
LT GN
REG
F G
ALT
SUPPLY
POS
FOOT SWITCH
DK BL
REAR LAMPS
A/C FUSE HOLDER
FRONT LAMPS
FRONT WARNING HORN
STARTING MOTOR
GLOW PLUGS
12V
12V
DISCONNECT SWITCH

ABBR.	COLOR
R	RED
B	BLACK
W	WHITE
O	ORANGE
GY	GRAY
BR	BROWN
DK BL	DARK BLUE
DK GN	DARK GREEN
PU	PURPLE
LT GN	LIGHT GREEN

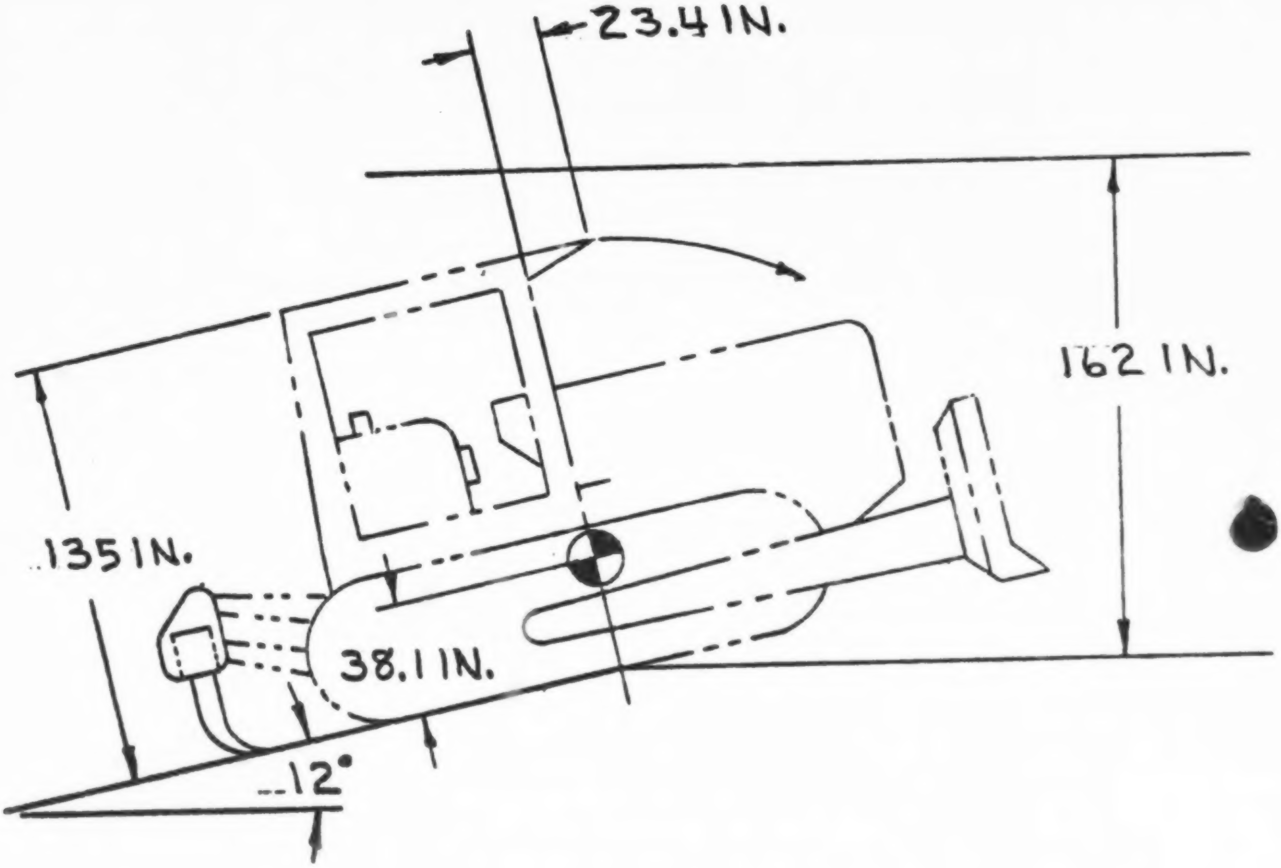
SYMBOL	DESCRIPTION
○	WIRING TERMINAL
●	SPLICE OR JUNCTION OF WIRES
+	CROSSING OF UNCONNECTED WIRES
⊣ı	VISIBLE GROUND (EXTERNAL)
⋯	INVISIBLE GROUND (INTERNAL)


.7 IN.
38.1 IN.
69.5 IN.

C.G. D8K WITH WINCH AND ANGLE DOZER

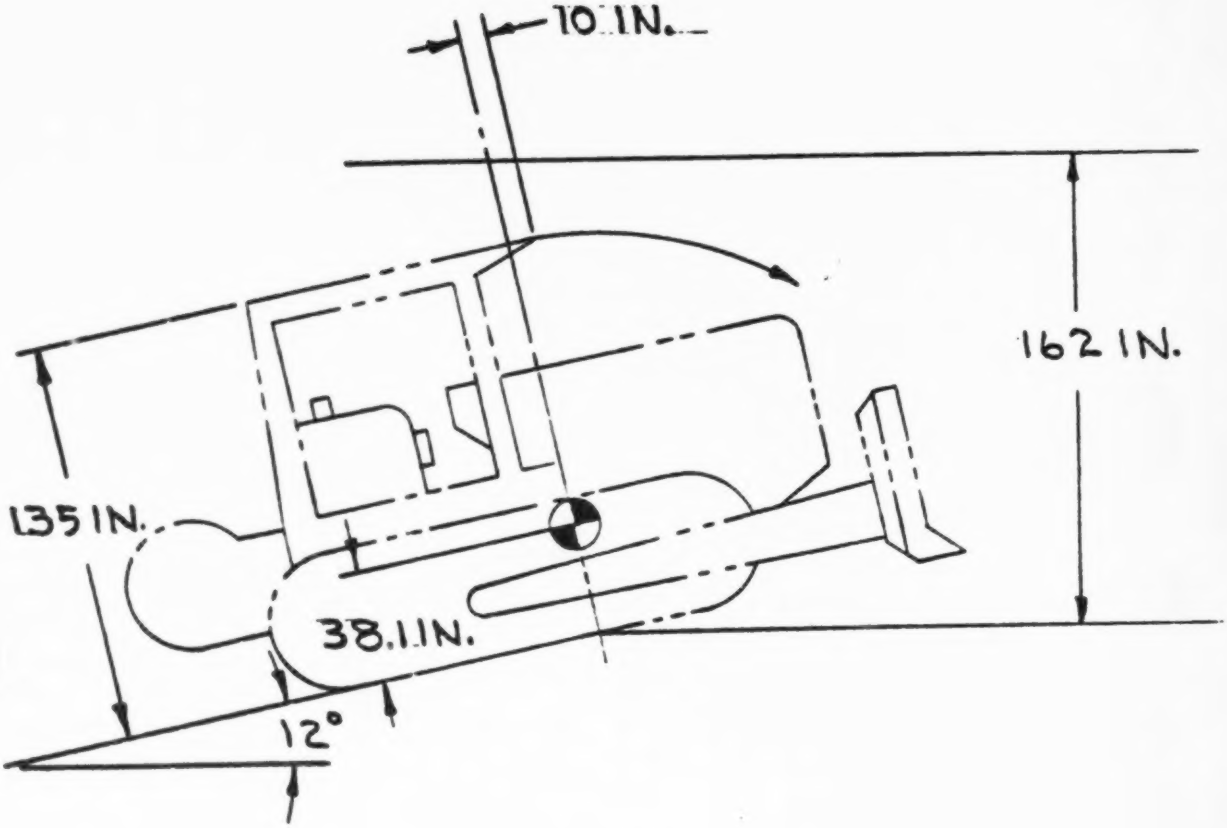

.7IN
38.1 IN
56.1.IN.

C.G. D8K WITH RIPPER AND STRAIGHT DOZER


23.4 IN.
162 IN.
135 IN.
38.1 IN.
12°

C5A LOADING DIAGRAM FOR D8K WITH RIPPER

NOTE
DRAWING IN SCALE ONLY FOR DIMENSIONS SHOWN


10 IN.
162 IN.
135 IN.
38.1 IN.
12°

C5A LOADING DIAGRAM FOR D8K WITH WINCH

NOTE
DRAWING IN SCALE ONLY FOR DIMINSIONS SHOWN

APPENDIX P
CATERPILLAR DEALER LOCATIONS
(CONUS & O/CONUS)

CATERPILLAR

U.S. COMMERCIAL DIVISION DEALERS

PEORIA, ILLINOIS 61629
JOLIET, ILLINOIS 60434
DECATUR, ILLINOIS 62525

MOSSVILLE, ILLINOIS 61552
AURORA, ILLINOIS 60507
DAVENPORT, IOWA 52800

SAN LEANDRO, CALIFORNIA 94577
YORK, PENNSYLVANIA 17405
MILWAUKEE, WISCONSIN 53201

WASHINGTON, D.C. 20006
Suite 925, International Square
1850 K. Street N.W.
Phone: Area 202, 466-5090

ADMINISTRATION BUILDING

PEORIA, ILLINOIS 61629

DIRECT DISTANCE DIALING . . . . CENTREX
AREA CODE 309—PREFIX 675—EXT. NO.—EXAMPLE: 309, 675-4117

U.S. COMMERCIAL DIVISION

VICE PRESIDENT	5106

DEALER ADMINISTRATION

MANAGER	4694
Northeastern Division Manager	4682
Southeastern Division Manager	5321
Central Division Manager	4425
Western Division Manager	4878
Dealer Promotion Manager	4463

FINANCE

MANAGER	4601
Northeastern Division Manager	4423
Southeastern Division Manager	4892
Central Division Manager	4647
Western Division Manager	4700
Finance Services Manager	4099

MACHINE SALES

MANAGER	4095
Northeastern Division Manager	4668
Southeastern Division Manager	4666
Central Division Manager	4097
Western Division Manager	4458
National Sales Division Manager	4701

PARTS SALES

MANAGER	5165
Northeastern Division Manager	4260
Southeastern Division Manager	4779
Central Division Manager	4781
Western Division Manager	4783
Parts Operations Division Manager	4891

SERVICE

MANAGER	4603
Northeastern Division Manager	4003
Southeastern Division Manager	4606
Central Division Manager	4018
Western Division Manager	4089
National Service	5040

ALABAMA

D060 MONTGOMERY 36102
Burford Equipment Co.
I-85 East, Mt. Meigs—Mitylene Exit II
Mail Address: P.O. Box 1591
Phone: Area 205, 277-7000
Telex: 59-3445

D061 MOBILE 36601
Burford Equipment Co.
2521 Halls Mill Road
Mail Address: P.O. Box 2083
Phone: Area 205, 473-8632
Telex: 50-5443
Branch:
Marianna, Florida

D430 BIRMINGHAM 35202
Thompson Tractor Co., Inc.
2401 Pinson Highway—Zip 35217
(Tarrant, AL)
Mail Address: P.O. Box 10367
Phone: Area 205, 841-8601

D433 ANNISTON 36201
Thompson Tractor Co., Inc.
2300 Highway 21, South (Oxford) Shipping
P.O. Box 1648, Oxford, AL 36201—Mail
Phone: Area 205, 831-4104

D431 DECATUR 35601
Thompson Tractor Co., Inc.
U.S. Highway 31 North
Box No. 1603
Phone: Area 205, 353-7721

D432 TUSCALOOSA 35401
Thompson Tractor Co., Inc.
3537 Skyland Blvd. East (U.S. 11 Bypass)
P.O. Box 5268
Phone: Area 205, 553-5511

ALASKA

Branches of *N C MACHINERY CO. in Alaska

H342 ANCHORAGE 99502
*N C Machinery Co.
6450 Artic Boulevard
P.O. Box 6148
Phone: Area 907, 278-1531

H345 FAIRBANKS 99707
*N C Machinery Co.
Steese Highway & Trainer Gate Road
P.O. Box 1539
Phone: Area 907, 452-7251

H344 JUNEAU 99803
*N C Machinery Co.
8550 Airport Blvd.
P.O. Box 2138
Phone: Area 907, 789-0181

ALASKA (Continued)

H343 KETCHIKAN 99901
*N C Machinery Co.
126 Washington Street
P.O. Box 7358
Phone: Area 907, 225-6111
Main Office:
Seattle, Washington
Branches:
Mt. Vernon, Washington
Chehalis, Washington

ARIZONA

H040 YUMA 85364
Braden Machinery Co.
400 E. 16th St.
P.O. Box 1631
Phone: Area 602, 783-7866

H041 WELLTON 85356
Braden Machinery Co.
East Highway 80
P.O. Box 188
Phone: Area 602, 785-3391
Branches:
Blythe, California
Imperial, California
Mexicali, Baja California, Mexico
San Luis, R.C. Sonora, Mexico

H160 PHOENIX 85062
Empire Machinery Co.
1725 S. County Club Drive
Mesa, Arizona 85202—Shipping
Phone: Area 602, 834-3600
Telex: 668-407
MAILING ADDRESS:
P.O. Box 2985
Phoenix, Arizona 85062

H162 FLAGSTAFF 86002
Empire Machinery Co.
Industrial Park 86001—Shipping
P.O. Box 340
Phone: Area 602, 526-2800

H163 TUCSON 85734
Empire Machinery Co.
7600 South Nogales Highway—85706
P.O. Box 11250
Phone: Area 602, 746-1441

H165 KINGMAN 86401
Empire Machinery Co.
1143 W. Beale—Shipping
P.O. Box 1069—Mail
Phone: Area 602, 753-5284
Subsidiary:
Canenea, Sonora, Mexico

---

*Division of Northern Commercial Company

Main offices in larger-faced type
Branches in smaller-faced type
Alpha-Numerics designate Dealer Code

ARKANSAS

D310 LITTLE ROCK 72203
J.A. Riggs Tractor Company
7701 New Benton Highway
P.O. Box 1399
Phone: Area 501, 568-1021
Telex: 053-6477

D312 FORT SMITH 72901
J.A. Riggs Tractor Company
South 71 Highway at Fort Chaffee Road
P.O. Box 1444
Phone: Area 501, 646-4755
Telex: 053-7431

D313 McGEHEE 71654
J.A. Riggs Tractor Company
Highway 65 South
P.O. Box 411
Phone: Area 501, 222-3566
Telex: 053-6236

D314 TEXARKANA 75501
J.A. Riggs Tractor Company
Highway 67 North
P.O. Box 2042
Phone: Area 501, 773-5621
Telex: 053-6231

D311 WEST MEMPHIS 72301
J.A. Riggs Tractor Company
2108 E. Broadway
P.O. Box 650
Phone: Area 501, 735-2563
Telex: 053-3105

D282 HARRISON 72601
E.A. Martin Machinery Co.
P.O. Box 250
U.S. Highway 65 North
Phone: Area 501, 741-8251
Main Office:
Springfield, Missouri
Branches:
Joplin, Missouri
West Plains, Missouri

CALIFORNIA

H020 NAPA 94558
Berglund, Inc.
150 Camino Dorado
Napa Valley Business Park
P.O. Box 2089
Phone: Area 707, 252-2222

H021 WILLITS 95490
Berglund, Inc.
1600 So. Main Street
P.O. Box 627
Phone: Area 707, 459-5575

H043 BLYTHE 92225
Braden Machinery Co.
South Intake Boulevard
P. O. Box R
Phone: Area 714, 922-2191
Main Office: Yuma, Arizona

CALIFORNIA (Continued)

H044 IMPERIAL 92251
Braden Machinery Co.
3393 Highway 86
P.O. Box 936
Phone: Area 714, 355-2443
Main Office:
Yuma, Arizona

H050 EUREKA 95501
Matthews Machinery Co.
3990 Broadway
Mail Address: P.O. Box 3460
Phone: Area 707, 443-1653

H051 CRESCENT CITY 95531
Matthews Machinery Co.
800 Northcrest Drive
P.O. Box 386
Phone: Area 707, 464-2126

H190 SAN DIEGO 92112
Hawthorne Machinery Co.
4200 Kearney Mesa Rd.—92111
Mail Address: P.O. Box 708
Phone: Area 714, 277-2260
Telex: 695022

H192 SAN DIEGO 92112
(e) Hawthorne Engine Systems
8050 Othello St.—92111
P.O. Box 708
Phone: Area 714, 277-2260
Telex: 695022
Branch:
Tijuana, B.C., Mexico

H200 STOCKTON 95208
Holt Bros.
1521 W. Charter Way
(ZIP: 95206) (Shipping)
P.O. Box 8130
Phone: Area 209, 466-6000
Telex: 359428

H202 LOS BANOS 93635
Holt Bros.
3440 E. Pacheco Blvd.
P.O. Box 1028
Phone: Area 209, 826-4919

H270 RIVERSIDE 92502
Johnson Tractor Co.
800 East La Cadena Drive (ZIP: 92501)
P.O. Box 351
Phone: Area 714, 686-4560

H273 RIVERSIDE 92502
(e) Johnson Industrial
A Division of Johnson Tractor Co.
656 East La Cadena Drive 92501
P.O. Box 351
Phone: Area 714, 683-5960

CALIFORNIA (Continued)

H370 SAN LEANDRO 94577
Peterson Tractor Co.
955 Marina Blvd.
P.O. Box 5258
Phone: Area 415, 357-6200
Telex: 33-5350

H371 CHICO 95926
Peterson Tractor Co
Highway 99E South
P.O. Box 340
Phone: Area 916, 343-1911

H372 REDDING 96001
Peterson Tractor Co
5100 Caterpillar Road
P.O. Box 940
Phone: Area 916, 243-5410

H374 SAN LEANDRO 94577
(e) Peterson Power Company
2828 Teagarden Street
Phone: 415, 895-8400

H390 FRESNO 93778
Quinn Company
14 miles south of Fresno on
Golden State Blvd., Fresno
County, CA 93662
Mail Address: P.O. Box 12625
Phone: Area 209, 896-4040

H395 FRESNO 93778
(e) Quinn Company
Old Highway 99 South
Phone: Area 209, 896-4040

H392 SALINAS 93901
Quinn Company
1300 Abbott Street
P.O. Box 1908 (Mail)
Phone: Area 408, 758-8461

H430 LOS ANGELES 90022
Shepherd Machinery Co.
I-605 at Rose Hills Road
Box 6789, Los Angeles—Mail
Phones: Area 213, 723-7191 and 692-3751
Telex: 67-0459

H434 CALABASAS 91302
Shepherd Machinery Corporation
4785 N. Las Virgenes Rd.
Phone: Area 213, 880-4391

H432 IRVINE 92650
Shepherd Machinery Corporation
6565 Laguna Road
Box 16, East Irvine—Mail
Phone: Area 714, 551-4161

H433 CASTAIC 91350
Shepherd Tractor
28234 Old Road (Valencia, CA)
P.O. Box 400 (Saugus, CA—Mail)
Phone: Area 805, 257-3441

CALIFORNIA (Continued)

H431 LANCASTER 93534
Shepherd Tractor
46117 N. Sierra Highway
Phone: Area 805, 942-1177

H380 LOS ANGELES 90022
(e) POWER SYSTEMS Associates
100 Industry Street
(City of Industry) 91743
Box 7044, Los Angeles—Mail
Phone: Area 213, 692-3751

H440 SACRAMENTO 95827
TENCO TRACTOR, INC.
El Centro Rd. (Hwy. 70/99) at Riego Rd.
Pacific Avenue, South Sutter County 95813
P.O. Box X (Mail) ZIP 95813
Phone: Area 916, 655-3131

H490 OXNARD 93031
Wallace Machinery Co.
Highway 101 & Rose Ave.—Zip 93030
P.O. Box 5992 (Mail)
Phone: Area 805, 485-2171

H493 BAKERSFIELD 93308
Wallace Machinery Co
2200 Pegasus Road
Mail Address: P.O. Box 256
Phone: Area 805, 393-5800

H494 CORCORAN 93212
Wallace Machinery Co.
Central Valley Highway 43 at Pickerell Avenue
P.O. Box 578
Phone: Area 209, 992-2193

H492 PASO ROBLES 93446
Wallace Machinery Co.
2 mi. East of Town on Hiway 46
P.O. Box 276 (Mail)
Phone: Area 805, 238-4811

H491 SANTA MARIA 93456
Wallace Machinery Co
1655 Carlotti Drive
U.S. 101 at Donovan Road (Delivery)—Zip 93454
P.O. Box 1220 (Mail)
Phone: Area 805, 925-8611

H570 COLUSA 95932
I.G. Zumwalt Co.
850 Market St.
Mail: P.O. Box 149
Phone: Area 916, 458-2135

H571 WILLOWS 95988
I.G. Zumwalt Co.
311 N. Butte St
P.O. Box 907
Phone: Area 916, 934-5427

(e) Engine Branch

Main offices in larger-faced type
Branches in smaller-faced type
Alpha-Numerics designate Dealer Code

COLORADO

E250 DENVER 80217
Wagner Equipment Co.
6000 Dahlia Street, Commerce City
Zip 80022
Mail Address: P.O. Box 5188
Phone: Area 303, 289-6111

E251 DURANGO 81301
Wagner Equipment Co.
260 E. Fourth Street
P.O. Box 949
Phone: Area 303, 247-2404

E252 GRAND JUNCTION 81501
Wagner Equipment Co.
2707 U.S. Hwy. 50, Orchard Mesa
P.O. Box 2009
Phone: Area 303, 242-2834

E253 PUEBLO 81002
Wagner Equipment Co.
214 E. Ilex
P.O. Box 496
Phone: Area 303, 544-4433

E254 HAYDEN 81639
Wagner Equipment Co.
265 S. Poplar
P.O. Box II—Mail
Phone: Area 303, 276-3771

CONNECTICUT

B374 NEWINGTON 06111
H.O. Penn Machinery Company, Inc.
225 Richard St.
Phones: Area 203, 666-8401
Telex: 99336
Main Office:
Armonk, New York
Branches:
Bronx, New York
Poughkeepsi, New York
Tuxedo, New York
Westbury, LI, New York

DELAWARE

B191 BEAR 19701 (Wilmington Area)
Giles & Ransome, Inc.
U.S. Route 40
Phone: Area 302, 328-4131
Main Office Address:
Bensalem, Pennsylvania

DISTRICT OF COLUMBIA

See Springfield, Va., Alban Tractor Co., Inc.

FLORIDA

D260 MIAMI 33152
Kelly Tractor Co.
8255 N.W. 58th Street
P.O. Box 520775
Phone: Area 305, 592-5360
Telex: 51-8823

D262 CLEWISTON 33440
Kelly Tractor Co.
800 E. Sugarland Highway
Phone: Area 813, 983-8177

D263 FT MYERS 33908
Kelly Tractor Co.
Route 13, Box 1500
Phone: Area 813, 481-3733

D261 WEST PALM BEACH 33409
Kelly Tractor Co.
5460 Okeechobee Blvd.
Phone: Area 305, 683-1231

D350 JACKSONVILLE 32216
Ring Power Corporation
8050 Phillips Highway—Shipping
P.O. Box 17600—Mail
Phone: Area 904, 737-7730
Telex: 056-8472

D351 OCALA 32670
Ring Power Corporation
4251 S. Pine St.—Shipping
P.O. Box 850—Mail
Phone: Area 904, 622-3251

D352 TALLAHASSEE 32302
Ring Power Corporation
4760 Capital Circle, N.W.—Shipping
P.O. Box 869—Mail
Phone: Area 904, 386-2121

D360 TAMPA 33601
Jos. L. Rozier Machinery Co.
1219 North Highway 301
P.O. Box 1872
Phone: Area 813, 621-5851
Telex: 052-804

D361 ORLANDO 32809
Jos. L. Rozier Machinery Co.
1250 W. Landstreet Road
P.O. Box 13177-A
Phone: Area 305, 859-5600

D062 MARIANNA 32446
Burford Equipment Co.
U.S. Highway 90, West
P.O. Box 637
Phone: Area 904, 526-2241
Telex: 70-2449
Main Office:
Montgomery, Alabama

Main offices in larger-faced type
Branches in smaller-faced type
Alpha-Numerics designate Dealer Code

GEORGIA

D080 ALBANY 31702
Carlton Company
P.O. Box 1087
1604 South Slappey Blvd. ZIP: 31701
Phone: Area 912, 435-6262
TWX: 810 781 5103

D081 BRUNSWICK 31520
Carlton Company
106 Perry Lane Rd
P O Box 310
Phone Area 912, 265-5010
TWX 810-782-5065

D082 DUBLIN 31021
Carlton Company
Macon Road, Highway 80 West
P O Box 909
Phone Area 912, 272-1661
TWX 810-788-5243

D083 SAVANNAH 31402
Carlton Company
Highway 80 West
P O Box 1056
Phone Area 912, 964-7150
TWX 810-784-5643

D500 ATLANTA 30336
Yancey Bros. Co.
Mail: P.O. Box 43326
Shipping: 7333 Lee Industrial Blvd.
Austell, Georgia 30001
Phone: Area 404, 941-2300

D501 AUGUSTA 30906
Yancey Bros Co
3825 Highway 56 South
Phone Area 404, 790-1300

D502 MACON 31206
Yancey Bros Co
4660 Broadway
Phone Area 912, 788-1773

GUAM

H143 AGANA 96910
PACIFIC MACHINERY,
division of Theo. H. Davies & Co., Ltd.
P.O. Box DT
Phone: Guam 646-4479
Cable Address: PAMACAT, AGANA, GUAM
Telex: RCA 721152
Main Office:
Waipahu, Oahu, Hawaii

HAWAII

H140 WAIPAHU, OAHU 96797
PACIFIC MACHINERY,
division of Theo. H. Davies & Co., Ltd.
94-025 Farrington Highway
Phone: Area 808, 677-9111
Cable Address: PAMACAT, WAIPAHU
Telex: RCA 723397
Western Union Hawaii:
(AC 709) 392441

H144 HILO 96720
PACIFIC MACHINERY,
division of Theo. H. Davies & Co., Ltd
456 Kalanianaole Avenue
Phone: (808) 961-3437
Cable Address: PAMACAT, HILO
Telex: Western Union of Hawaii
(AC 709) 392407

H141 KAHULUI, MAUI 96732
PACIFIC MACHINERY,
division of Theo. H. Davies & Co., Ltd
470 South Hana Highway
Phone: (808) 877-6538
Cable Address: PAMACAT, MAUI
Telex: Western Union of Hawaii:
(AC 709) 392467

H142 LIHUE, KAUAI 96766
PACIFIC MACHINERY,
division of Theo. H. Davies & Co., Ltd.
P.O. Box 1546
Phone: (808) 245-4057
Cable Address: PAMACAT, KAUAI
Telex: Western Union of Hawaii:
(AC 709) 392477

IDAHO

H603 GRANGEVILLE 83530
(A) Brown Motors, Inc.
West 118 South St.
P.O. Box 232
Phone: Area 208, 983-1730

H320 LEWISTON 83501
Nez Perce Tractor Co.
Highway 12 East
P. O. Box 1127
Phone: Area 208, 746-3301

H510 BOISE 83707
Western Equipment Company
4009 Fairview Avenue
Mail Address: P.O. Box 38
Phone: Area 208, 343-5401

(A) Agricultural Dealer

Main offices in larger-faced type
Branches in smaller-faced type
Alpha-Numerics designate Dealer Code

IDAHO (Continued)

H511 POCATELLO 83201
Western Equipment Company
2405 U.S. Highway 30 West
P.O. Box 4640
Phone: Area 208, 232-2640
Branches:
John Day, Oregon
LaGrande, Oregon

H634 MOSCOW 83843
(A) Everett Will Tractor Company, Inc.
218 No. Main Street
P.O. Box 8579
Phone: Area 208, 882-7537

ILLINOIS

B130 SPRINGFIELD 62705
Capitol Machinery Co.
Interstate 55 and Toronto Road
P.O. Box 2008
Phone: Area 217, 529-5541

B131 CHAMPAIGN 61820
Capitol Machinery Co.
Interstate 74 at Lincoln Interchange
P.O. Box 156
Phone: Area 217, 359-1671

D123 MARION 62959
Fabick Machinery Company
Highway 13 East
P.O. Box 166
Phone: Area 618, 993-2191

D124 SALEM 62881
Fabic Tractor Company
U.S. Highway 50 West
Mail Address: P.O. Box 530
Phone: Area 618, 548-1400
TWX: 910-996-2690

D125 CROSSVILLE 62827
Fabick Tractor Company
P.O. Box 217
Intersection Hwy. 460 & 1
Phone: Area 618, 966-3880
Main Office:
Fenton, St. Louis County, Missouri
Branches:
Jefferson City, Missouri
Sikeston, Missouri

B350 ELMHURST 60126
Patten Industries, Inc.
635 W. Lake Street
Phone: Area 312, 279-4400 (Suburban)
Phone: Chicago: Area 312, 626-1860

B353 OGLESBY 61348
Patten Industries, Inc.
590 Mayers St.
Phone: Area 815, 883-3336

ILLINOIS (Continued)

B352 ROCKFORD 61102
Patten Industries, Inc.
5055 South Main Street
Phone: Area 815, 965-8631
Branch:
Hammond, Indiana

B360 ELMHURST 60126
(e) POWERTON, INC.
615 West Lake Street
Phone: Area 312, 530-2200

B390 PEORIA 61654
Peoria Tractor & Equipment Co.
2319 E. War Memorial Drive
P.O. Box 1318 (ZIP: 61601)
Phone: Area 309, 682-5481

INDIANA

B270 INDIANAPOLIS 46206
MacAllister Machinery Co., Inc.
P.O. Box 1941
7515 E. 30th Street
Phone: Area 317, 545-2151

B272 ELKHART 46514
MacAllister Machinery Co., Inc.
2019 West Lusher Ave.
Phone: Area 219, 294-7402

B271 FORT WAYNE 46801
MacAllister Machinery Co., Inc.
2418 W. Coliseum Blvd.
P.O. Box 276
Phone: Area 219, 483-6469

B273 WASHINGTON 47501
MacAllister Machinery Co., Inc.
1407 South State Road 57
Phone: Area 812, 254-1712

B351 HAMMOND 46320
Patten Industries, Inc.
6400 Indianapolis Blvd.
Phone: Chicago: Area 312, 721-6977
Phone: Area 219, 932-6600 (Suburban)
Main Office:
Elmhurst, Illinois

D485 EVANSVILLE 47711
Whayne Supply Co.
2420 E. Lynch Rd.
P.O. Box 969—Zip 47706
Phone: Area 812, 425-4651
Main Office:
Louisville, Kentucky
Branches:
Ashland, Kentucky
Bowling Green, Kentucky
Corbin, Kentucky
Lexington, Kentucky
Paducah, Kentucky
Pikeville, Kentucky

(e) Engine Branch
(A) Agricultural Dealer

Main offices in larger-faced type
Branches in smaller-faced type
Alpha-Numerics designate Dealer Code

IOWA

B030 CEDAR RAPIDS 52406
Altorfer Machinery Company
2600 6th St., S.W.
P.O. Box 1347
Phone: Area 319, 365-0551

B031 DAVENPORT 52808
Altorfer Machinery Company
4712 Buckeye Street
P.O. Box 3007
Phone: Area 319, 324-1935
Branch
Hannibal, Mo

E160 DES MOINES 50304
Gibbs-Cook Equipment Co.
Hickman Road at 104th Street—
Zip 50322
P.O. Box 936
Phone: Area 515, 270-2800
Telex: 910-520-2695

E161 FORT DODGE 50501
Gibbs-Cook Equipment Co
3366 Fifth Ave South
Box 1013
Phone: Area 515, 576-3161

E162 MASON CITY 50401
Gibbs-Cook Equipment Co
325 North Jackson Street
Box 1037
Phone: Area 515, 423-7240

E163 POSTVILLE 52162
Gibbs-Cook Equipment Co
308 N. Lawler
Box 537
Phone: Area 319, 864-7461

E291 SIOUX CITY 51102
Missouri Valley Machinery Co
5001 Gordon Drive East
Phone: Area 712, 276-2431
Main Office
Omaha, Nebraska

KANSAS

E130 WICHITA 67213
Foley Tractor Co.
1550 South West Street
Phone: Area 316, 943-4211

E134 DODGE CITY 67801
Foley Tractor Co
1600 E. Wyatt Earp Blvd
P.O. Box 1268 (Mail)
Phone: Area 316, 225-4121

E131 GREAT BEND 67530
Foley Tractor Co.
3701 West 10th Street
P.O. Box 310 (Mail)
Phone: Area 316, 792-4861

KANSAS (Continued)

E133 SALINA 67401
Foley Tractor Co
529 North Broadway
P.O. Box 147 (Mail)
Phone: Area 913, 825-4661

E270 TOPEKA 66601
Martin Tractor Company, Inc.
1737 Southwest 42nd Street
P.O. Box 1698
Phone: Area 913, 266-5770

E271 CHANUTE 66720
Martin Tractor Company, Inc
501 W. 35th Street
P.O. Box 683
Phone: Area 316, 431-3600

E273 COLBY 67701
Martin Tractor Company, Inc
1080 South Range
P.O. Box 385
Phone: Area 913, 462-3913

E272 CONCORDIA 66901
Martin Tractor Company, Inc
1805 Lincoln Street
P.O. Box 447
Phone: Area 913, 243-1960

KENTUCKY

D480 LOUISVILLE 40201
Whayne Supply Company
1400 S. 43rd Street (ZIP: 40211)
P.O. Box 1737
Phone: Area 502, 774-4441
Telex: 20-4222

D481 ASHLAND 41101
Whayne Supply Company
23rd and Greenup Streets
P.O. Box 1178
Phone: Area 606, 324-2114

D482 BOWLING GREEN 42101
Whayne Supply Company
U.S. Highway 31-W By-Pass
P.O. Box 1093
Phone: Area 502, 843-3275

D483 CORBIN 40701
Whayne Supply Company
2200 S. Kentucky St. S.W.
P.O. Box 536
Phone: Area 606, 528-3140

D486 LEXINGTON 40589
Whayne Supply Company
195 Lisle Road
P.O. Box 1123
Phone: Area 606, 254-2756

Main offices in larger-faced type
Branches in smaller-faced type
Alpha-Numerics designate Dealer Code

KENTUCKY (Continued)

D484 PADUCAH 42001
Whayne Supply Company
1600 North 8th Street
P.O. Box 2355
Phone: Area 502, 443-3631

D487 PIKEVILLE 41501
Whayne Supply Company
U.S. 23 South
P.O. Box 2559
Phone: Area 606, 437-6265
Branch:
Evansville, Ind.

LOUISIANA

D030 RESERVE 70084
Boyce Machinery Corporation
100 Airline Highway
P.O. Drawer AJ
Phone: Area 504, 536-1121
Telex: 58371

D031 LAKE CHARLES 70604
Boyce Machinery Corporation
5415 East Broad Street
P.O. Box 1227
Phone: Area 318, 439-3601

D032 MORGAN CITY 70380
Boyce Machinery Corporation
Highway 90, East
P.O. Box 310
Phone: Area 504, 631-0561

D270 MONROE 71203
Louisiana Machinery Company, Inc.
U.S. Highway 165 By-Pass at Ticheli Road
Mail Address: P.O. Box 4888
Phone: Area 318, 323-1345

D272 ALEXANDRIA 71301
Louisiana Machinery Company, Inc.
MacArthur at Masonic Drive
P.O. Box 5544
Phone: Area 318, 443-2577

D271 BOSSIER CITY 71111
Louisiana Machinery Company, Inc.
2430 East Texas Ave.
P.O. Box 5375
Phone: Area 318, 746-2341

D273 VIDALIA 71373
Louisiana Machinery Company, Inc.
400 Carter St.
Phone: Area 318, 336-4243

D274 SHREVEPORT 71107
Louisiana Machinery Company, Inc.
521 North Market Street—Mail & Shipping
Phone: Area 318, 227-8835

MAINE

D050 PORTLAND 04104
Arnold Machinery Co.
173 Presumpscot Street
P.O. Box 1080
Phone: Area 207, 775-3121

B051 BANGOR 04401
Arnold Machinery Co.
1070 Hammond Street
P.O. Box 783
Phone: Area 207, 942-4666

MARYLAND

B010 BALTIMORE 21237
Alban Tractor Co., Inc.
8531 Pulaski Highway
P.O. Box 9595
Phone: Area 301, 686-7777

B011 MYERSVILLE 21773
Alban Tractor Co., Inc.
Interstate 70 at Myersville Interchange
P.O. Box 48 (Mail)
Phone: Area 301, 293-2377

B012 SALISBURY 21801
Alban Tractor Co., Inc.
Route 6
P.O. Box 419
Phone: Area 301, 749-5240
Branch:
Springfield, Va.

B020 BALTIMORE 21227
(e) Atlantic Engine Power, Inc.
6455 Washington Blvd.
Phone: Area 301, 796-8000

MASSACHUSETTS

B450 HOPKINTON 01748
Witt-Armstrong Equipment Co.
80 South Street
Exit 21W off Rt. 495
Phone: Area 617, 435-6321
Telex: 948492

B451 MATTAPOISETT 02739
Witt-Armstrong Equipment Co.
Industrial Drive off North Street Interchange
P.O. Box 728
Phone: Area 617, 758-4933

B452 SOUTH HADLEY 01075
Witt-Armstrong Equipment Co.
600 New Ludlow Road
Phone: Area 413, 536-4580

MEXICO (USCD Territory Portion)

H045 MEXICALI, B.C. MEXICO
Braden Machinery Co.
Maquinaria Frontera, S.A. de C.V.
Carretera A San Luis Km. 3-½
Aparatado Postal 638
Phone: Area 903, 767-2085
U.S. Address:
P.O. Box 89
Calexico, California 92231
Main Office, Yuma, Arizona

H042 SAN LUIS R.C., SONORA, MEXICO
Braden Machinery Co.
Maquinaria Agricola del Colorado,
S.A. de C.V.
Carretera a Riito Km. 3
Apartado Postal 65
Phone: Area 903, 794-2252
U.S. Address:
P.O. Box 62
San Luis, Arizona 85349
Main Office: Yuma, Arizona

H166 CANANEA, SONORA, MEXICO
Empire Machinery Co.
Maquinaria Imperial, S.A. (Subsidiary)
Av. Obregon, No. 222
APDO 143
Phone: 2-1400

P.O. Box 1817 (Parcel Post)
Bisbee, Arizona 85603
Main Office:
Phoenix, Arizona

H191 TIJUANA, B.C., MEXICO
Hawthorne Machinery Co.
Maquinaria de Baja California, S.A. de C.V.
Apartado No. 106
Blvd. Salinas y Paniagua
Phone: Area 903, 386-1460
Main Office:
San Diego, California

MICHIGAN

B261 MARQUETTE 49855
Kramer Machinery Inc.
6 miles west on Highway 41
P.O. Box 638
Phone: Area 906, 475-4191
Mail Office:
Green Bay, Wis.

B290 NOVI 48050
Michigan Tractor & Machinery Co.
24800 Novi Road
Mail Address: P.O. Box 354
Phone: Area 313, 349-4800
Telex: 23-5491

B291 .GRAND RAPIDS 49509
Michigan Tractor & Machinery Co.
4350 Clyde Park Avenue, S.W.
P.O. Box 9220 (Mail)
Phone: Area 616, 532-3633

MICHIGAN (Continued)

B292 KALKASKA 49646
Michigan Tractor & Machinery Co.
3990 U.S. 131—Route #4
Phone: Area 616, 258-8674

B293 NOVI 48050
(e) Michigan Engine Power
Division of Michigan Tractor & Machinery Co.
25000 Novi Road
Phone: Area 313, 349-7050

MINNESOTA

E500 MINNEAPOLIS 55420
ZIEGLER INC.
901 W. 94th Street (Bloomington)
Phone: Area 612, 888-4121

E501 CROOKSTON 56716
ZIEGLER INC.
1115 South Main Street
Phone: Area 218, 281-4245

E502 HIBBING 55746
(e) ZIEGLER INC.
505 West 37th Street
Phone: Area 218, 262-5231

E507 DULUTH 55800
ZIEGLER INC.
210 Garfield Avenue
Phone: Area 218, 722-6628

E503 BUHL 55713
ZIEGLER INC.
East Highway #169
P.O. Box 730
Phone: Area 218, 258-3232

E504 MARSHALL 56258
ZIEGLER INC.
Highway 59 North
Phone: Area 507, 532-4403

E506 EDINA 55435
(e) ZIEGLER INC.
ENGINE DIVISION
7175 Cahill Road
Phone: Area 612, 941-3200

MISSISSIPPI

D410 GREENWOOD 38930
Stribling-Clements, Inc.
1208 Highway 82 West
P.O. Box 676
Phone: Area 601, 453-5233
Telex: 585 352 STRIBCLEM GRWD

D411 COLUMBUS 39701
Stribling-Clements, Inc.
2101 Hwy. 82 West
P.O. Box 1047
Phone: Area 601, 327-3063

best copy available

MISSISSIPPI (Continued)

D440 JACKSON 39207
Stribling-Pucket, Inc.
3263 Highway 80 West—Zip 39207
Box 3170
Phone: Area 601, 969-6000

D441 GULFPORT 39503
Stribling-Pucket, Inc.
Highway 49 North
P.O. Drawer 2579
Phone: Area 601, 832-1711

D443 MERIDIAN 39301
Stribling-Pucket, Inc.
1710 Tom Bailey Drive
P.O. Box 5467
Phone: Area 601, 483-4511

D442 NATCHEZ 39120
Stribling-Pucket, Inc.
Highway 61 North
P.O. Box 883
Phone: Area 601, 442-1633

D445 HATTIESBURG 39401
Stribling-Puckett, Inc.
Highway 49 South—Shipping
P.O. Box 1568—Mail
Phone: Area 601, 545-8500

D461 CLARKSDALE 38614
Taylor Machinery Company
Highway 322 South
P.O. Box 247
Phone: Area 601, 624-2581

D462 TUPELO 38801
Taylor Machinery Company
723 Westmoreland Drive
R.R. 8
Phone: Area 601, 844-1634
Mail Office:
Memphis, Tenn.

MISSOURI

B032 HANNIBAL 63401
Altorfer Machinery Company
3520 Moberly Avenue
P.O. Box 70
Phone: Area 314, 221-8600
Mail Office:
Cedar Rapids, Iowa

E100 KANSAS CITY 64141
Dean Machinery Co.
1201 West 31st Street—ZIP 64108
P.O. Box 1176
Phone: Area 816, 753-5300
Telex: 042337

E102 CHILLICOTHE 64601
Dean Machinery Co.
Highway 65, South
Phone: Area 816, 646-2080

MISSOURI (Continued)

E103 ST. JOSEPH 64503
Dean Machinery Co.
Highway 59 & Belt South
3619 Pear St.
P.O. Box 87, Station A
Phone: Area 816, 233-2516

E104 SEDALIA 65301
Dean Machinery Co.
1620 West Main
Phone: Area 816, 827-2455

D120 FENTON, ST. LOUIS COUNTY 63026
John Fabick Tractor Company
One Fabick Drive
P.O. Box 5901
Phone: Area 314, 343-5900
Telex: 0447325

D121 JEFFERSON CITY 65101
Fabick & Company
2009 Missouri Blvd.
Phone: Area 314, 636-3184

D122 SIKESTON 63801
Fabick Bros. Equipment Co.
912 South Main St.
Phone: Area 314, 471-5941 and in Cape
Girardeau, Area: 314, 335-5557
Branches:
Marion, Ill.
Salem, Ill.
Crossville, Ill.

D280 SPRINGFIELD 65801
E.A. Martin Machinery Company
2222 East Kearney Street
Mail P.O. Box 988, Jewell Station
Phone: Area 417, 866-6651

D281 JOPLIN 64801
E.A. Martin Machinery Company
3534 E. 20th Street (Shipping)
P.O. Box 820
Phone: Area 417, 624-3010

D283 WEST PLAINS 65775
E.A. Martin Machinery Company
U.S. Highway 63, North
P.O. Box F
Phone: Area 417, 256-6138
Branch:
Harrison, Ark.

MONTANA

E030 GREAT FALLS 59403
ABBCO, INC.
4001 Highway 87 NE Bypass
P.O. Box 2147
Phone: Area 406, 761-7900

MONTANA (Continued)

E601 CONRAD 59425
(A) Conrad Implement Co.
23 Second Avenue S.E.
P.O. Box 1207
Phone: Area 406, 278-5531

E400 BILLINGS 59107
Tractor & Equipment Co.
1835 Harnish Blvd., Zip 59101
P.O. Box 30158
Phone: Area 406, 656-0202

E401 SIDNEY 59270
Tractor & Equipment Co.
201 North Central
P.O. Box 152
Phone: Area 406, 482-2430

H400 MISSOULA 59806
Long Machinery
3115 W. Broadway—Shipping-59801
P.O. Box 5508—Mail
Phone: Area 406, 721-4050

H401 KALISPELL 59901
Long Machinery
Highway 93 South—Shipping
P.O. Box 1717—Mail
Phone: Area 406, 257-5664

NEBRASKA

E220 LINCOLN 68501
Lincoln Equipment Company
930 West O Street
P.O. Box 81528
Phone: Area 402, 474-5566

E221 DONIPHAN 68832
Lincoln Equipment Company
U.S. Highway 281
P.O. Box L
Phone: Area 402, 845-6503

E290 OMAHA 68102
Missouri Valley Machinery Co.
401 North 12th St.
Phone: Area 402, 346-6500
Branch:
Sioux City, Iowa

E330 NORTH PLATTE 69101
Nebraska Machinery Company
I 80 and South Highway 83
P.O. Box 809
Phone: Area 308, 532-3100

E331 SCOTTSBLUFF 69361
Nebraska Machinery Company
1504-08 South Broadway
P.O. Box 519
Phone: Area 308, 632-6163

NEVADA

H070 LAS VEGAS 89106
Cashman Equipment Company
1132 West Bonanza Road
P.O. Box 4217, Annex
Phone: Area 702, 382-8891

H071 RENO 89510
Cashman Equipment Company
600 Glendale Road
P.O. Box 7520
Phone: Area 702, 358-5111

NEW HAMPSHIRE

B250 HOPKINTON 03301
Jordan Milton Machinery, Inc.
Exit 6, Interstate No. 89
Phone: Area 603, 746-4611
P.O. Box 206 (Mail)
Concord, New Hampshire 03301
Branch:
Montpelier, Vermont

NEW JERSEY

B170 PISCATAWAY 08854
Foley Machinery Co.
855 Centennial Avenue
P.O. Box 637 (Mail)
Phone: Area 201, 885-5555
Telex: 833-358

NEW MEXICO

E350 ALBUQUERQUE 87125
Rust Tractor Co.
4000 Osuna Rd. NE—Zip 87109
P.O. Box 25007
Phone: Area 505, 345-8411

E351 FARMINGTON 87401
Rust Tractor Co.
1000 Troy King Road
P.O. Box 2020
Phone: Area 505, 327-5331

E353 HOBBS 88240
Rust Tractor
W. Sanger and Truck Bypass
P.O. Box 856
Phone: Area 505, 393-2148
Branch:
El Paso, Texas

NEW YORK

B230 PLATTSBURGH 12901
Vincent S. Jerry & Sons, Inc.
5 MacDonough Street
P.O. Box 190
Phone: Area 518, 561-7700

(A) Agricultural Dealer

Main offices in larger-faced type
Branches in smaller-faced type
Alpha-Numerics designate Dealer Code

NEW YORK (Continued)

B231 MASSENA 13662
Vincent S. Jerry & Sons Corp.
Highland Road
P.O. Box 158
Phone: Area 315, 769-3521

B370 ARMONK 10504
H.O. Penn Machinery Company, Inc.
I-684 at Route 22
Phone: Area 914, 273-9800 and 212, 292-4800
Telex: 99-6512

B375 BRONX 10465
H.O. Penn Machinery Company, Inc.
699 Brush Avenue
Phone: Area, 212, 863-3800
Telex: 12-5232

B371 POUGHKEEPSIE 12603
H.O. Penn Machinery Company, Inc.
R.D. 2—Noxon Road
P.O. Box 3238
Phone: Area 914, 452-1200
Telex: 92-6409

B376 TUXEDO 10987
H.O. Penn Machinery Company, Inc.
Route 17, Orange Turnpike
Phone: Area 914, 351-4771

B373 WESTBURY, LONG ISLAND 11590
H.O. Penn Machinery Company, Inc.
1561 Stewart Avenue
Phone: Area 516, 334-7000
Telex: 96-1438
Branch:
Newington, Conn.

B410 ALBANY 12204
Southworth Machinery, Inc.
Glenwood Road—Menands
Hart's Lane
P.O. Box 4045—Patroon Station
Phone: Area 518, 465-5255

B430 SYRACUSE 13205
Syracuse Supply Company
294 Ainsley Drive
P.O. Box 37, Colvin Station (Mail)
(Construction Div.)
Phone: Area 315, 476-9981
(Main Office—Court St.)
Phone: Area 315, 463-9511
Telex: 93-7319

B431 BUFFALO 14217
Syracuse Supply Company
2140 Military Road
(ZIP: 14150) Tonawanda, NY
P.O. Box 147 (Mail), Kenmore, NY
Phone: Area 716, 694-7200
Telex: 91-317

NEW YORK (Continued)

B432 ROCHESTER 14623
Syracuse Supply Company
55 Manufacturers Blvd.
P.O. Box 9787—South Town Branch (Mail)
Phone: Area 716, 271-0560
Telex: 97-8479

B433 VESTAL 13850
Syracuse Supply Company
2909 Vestal Road
P. O. Box 7 (Mail) Southern Tier Branch
Phone: Area 607, 729-9121
Telex: 93-2434

NORTH CAROLINA

D090 CHARLOTTE 28213
Carolina Tractor & Equipment Co.
U.S. 21 North, Reames Road Exit-I-77
P. O. Box 26665
Phone: Area 704, 596-8790

D091 ASHVILLE 28803
Carolina Tractor & Equipment Co.
Fairview Road
P.O. Box 5637, Biltmore Station
Phone: Area 704, 274-7961

D092 GREENSBORO 27409
Carolina Tractor & Equipment Co.
I-40 at N.C. 68
P.O. Box 11435
Phone: Area 919, 668-2476

D093 HICKORY 28601
Carolina Tractor & Equipment Co.
903 1st. Ave. N.W.—Shipments
P.O. Box 2392—Mail
Phone: Area 704, 322-7360

D180 RALEIGH 27602
Gregory Poole Equipment Company
4807 Beryl Road
P.O. Box 469, Hillsborough St. Ext.
Phone: Area 919, 828-0641
TWX: 510-928-0536

D186 EDENTON 27932
Gregory Poole Equipment Company
P.O. Box 50
Guadacanal Rd.
Edenton, Airport
Phone: Area 919, 482-8408
TWX: 710-873-8107

D181 WASHINGTON 27889
Gregory Poole Equipment Company
P.O. Box 1178
U.S. 17 North & Spring Road
Phone: Area 919, 946-1081
TWX: 510-924-1811

D182 WILMINGTON 28401
Gregory Poole Equipment Company
U.S. 17 South
P.O. Box 839
Phone: Area 919, 371-6301
TWX: 510-937-0207

Main offices in larger-faced type
Branches in smaller-faced type
Alpha-Numerics designate Dealer Code

NORTH CAROLINA (Continued)

D184 FAYETTEVILLE 28348
Gregory Poole Equipment Company
U.S. 301 South at NC 59—Shipments
P.O. Box 387—Mail
(Hope Mills, NC)
Phone: Area 919, 424-4400

NORTH DAKOTA

E070 FARGO 58108
Butler Machinery Company
3500 W. Main Avenue
Box 2587 (Mail)
Phone: Area 701, 280-3100

E072 BISMARCK 58501
Butler Machinery Company
3630 Capitol Ave.
P.O. Box 757
Phone: Area 701, 223-0890

E071 GRAND FORKS 58201
Butler Machinery Company
111 Gateway Drive
P.O. Box 280
Phone: Area 701, 775-4238

E073 MINOT 58701
Butler Machinery Company
Highway 2, Bypass East
P.O. Box 1056
Phone: Area 701, 852-3508

OHIO

B070 COLUMBUS 43227
Barry Equipment Co.
P.O. Box 27040
3765 East Livingston Avenue
Phone: Area 614, 237-7491

B071 PERRYSBURG 43551
Barry Equipment Co.
25970 U.S. Highway 25 South
P.O. Box 192
Phone: Area 419, 874-7972

B210 CINCINNATI 45241
The Highway Equipment Company
3625 Hauck Road
Phone: Area 513, 563-2800
Telex: 21-4361

B211 PIKETON 45661
The Highway Equipment Company
535 S. West Street—State Route 23 South
P.O. Box 517
Phone: Area 614, 289-2349

B213 DAYTON 45404
The Highway Equipment Company
1639 Stanley Avenue
Phone: Area 513, 228-6404

OHIO (Continued)

B330 BROADVIEW HEIGHTS (Cleveland) 44147
Ohio Machinery Co.
3993 E. Royalton Road
(IR 77 at SR 82)
Phone: Area 216, 526-6200
Telex: 98 5563 OMCO CLV

B331 CADIZ 43907
Ohio Machinery Co.
U.S. Route 250-R.D. #1
P.O. Box 220
Phone: Area 614, 942-4626

B333 SOUTH ZANESVILLE 43701
Ohio Machinery Co.
3415 East Pike (IR 70 East)
P.O. Box 2428
Phone: Area 614, 453-0563

B332 YOUNGSTOWN 44501
Ohio Machinery Co.
4000 Lake Park Road
P.O. Box 1467
Phone: Area 216, 782-8161

OKLAHOMA

E010 TULSA 74145
Albert Equipment Co., Inc.
7794 East 42nd Place
P.O. Box 45688
Phone: Area 918, 627-4500
Telex: 49-2441 (Cable: ALBEQUIP)

E014 TULSA 74145
Albert Equipment Co., Inc.
4251 S. 76th E. Avenue
Phone: Area 918, 627-4500

E040 OKLAHOMA CITY 73125
Boecking Machinery, Inc.
4501 W. Reno—Zip 73127
Mail Address: P.O. Box 25947
Phone: Area 405, 947-6771
Telex: 747-205

OREGON

H180 PORTLAND 97208
Halton Tractor Co.
4421 N.E. Columbia Blvd.—97218
P.O. Box 3377
Phone: Area 503, 288-6411
Telex: 360272

H181 SALEM 97302
Halton Tractor Co.
2465 S.E. Madrona Ave.
Phone: Area 503, 585-7170

Main offices in larger-faced type
Branches in smaller-faced type
Alpha-Numerics designate Dealer Code

OREGON (Continued)

H183 THE DALLES 97058
Halton Tractor Co.
1238 W. 2nd St.
P.O. Box 293
Phone: Area 503, 296-4642
Branch:
Longview, Washington

H360 COBURG 97440
Pape' Bros., Inc.
Corporate Headquarters
Coburg Industrial Park
P.O. Box 407
Phone: 503, 342-1234

H360 EUGENE 97440
Pape' Bros., Inc.
2300 Henderson Avenue—I 5 South
at Glenwood Exit
P.O. Box 407
Phone: Area 503, 342-1234

H362 COOS BAY 97420
Pape' Bros., Inc.
1625 N. 7th Street & Kingwood Street
P.O. Box 396
Phone: Area 503, 267-2101

H363 KLAMATH FALLS 97601
Pape' Bros., Inc.
1410 S. Sixth St.
P.O. Box 1000 (Mail)
Phone: Area 503, 882-2544

H364 MEDFORD 97501
Pape' Bros., Inc.
2600 Biddle Road
P.O. Box 519
Phone: Area 503, 773-7514

H365 REDMOND 97756
Pape' Bros., Inc.
838 No. 5th
P.O. Box 698
Phone: Area 503, 548-2175

H361 ROSEBURG 97470
Pape' Bros., Inc.
3339 Old Hwy. 99 South
P.O. Box 1106
Phone: Area 503, 679-6711

H253 PENDLETON 97801
Inland Machinery Co.
1849 Westgate (Shipping)
P.O. Box 249
Phone: Area 503, 276-5812
Main office:
Yakima, Washington
Branches:
Pasco, Washington
Walla Walla, Washington

OREGON (Continued)

H513 JOHN DAY 97845
Western Equipment Co.
323 Canyon City Blvd.
Box 400
Phone: Area 503, 575-1301

H512 LAGRANDE 97850
Western Equipment Co.
1805 Adams Avenue
P.O. Box 400
Phone: Area 503, 963-3101
Main Office:
Boise, Idaho

PENNSYLVANIA

B090 PITTSBURGH 15221
Beckwith Machinery Co.
Route 22 East
P.O. Box 8718 (Mail)
Phone: Area 412, 327-1300, 243-0300
Teletype: 510-468-5404

B091 BRADFORD 16701
Beckwith Machinery Co.
361-369 Congress Street
Phone: Area 814, 368-3166
Teletype: 510-695-5224

B092 CLEARFIELD 16830
Beckwith Machinery Co.
Old Town Road
P.O. Box 510
Phone: Area 814, 765-9635
Teletype: 510-691-1765

B093 ERIE 16512
Beckwith Machinery Co.
1356 East 12th Street
Phone: Area 814, 454-2494
Teletype: 510-696-6864

B096 INDIANA 15701
Beckwith Machinery Co.
13th Street Extension
P.O. Box 236
Phone: Area 412, 463-8743

B097 SHIPPENVILLE 16254
Beckwith Machinery Co.
R.D. 2
Phone: Area 814, 226-4601

B095 SOMERSET 15501
Beckwith Machinery Co.
1001 North Center Avenue
P.O. Box 630
Phone: Area 814, 445-7915
Teletype: 510-463-9637
Branch:
Bridgeport, West Virginia

B150 HARRISBURG 17105
Cleveland Brothers Equipment Co., Inc.
5300 Paxton St. (Shipping)
P.O. Box 2535 (Mail)
Phone: Area 717, 564-2121

Main offices in larger-faced type
Branches in smaller-faced type
Alpha-Numerics designate Dealer Code

PENNSYLVANIA (Continued)

B156 ENGINE DIVISION (TRUCK ENGINE SERVICE)
4491 Chamber Hill Road (Shipping)
P.O. Box 2535 (Mail)
Phone: Area 717, 564-2121

B151 FRACKVILLE 17931
Cleveland Brothers Equipment Co., Inc.
State Road—Route 61
P.O. Box 4 (Mail)
Phone: Area 717, 874-3560

B155 MANSFIELD 16933
Cleveland Brothers Equipment Co., Inc.
R.D. #3—Route 6—Shipping
P.O. Box 264
Phone: Area 717, 662-7171

B152 PHILIPSBURG 16866
Cleveland Brothers Equipment Co., Inc.
307 Alder Street—Shipping
P.O. Box 431 (Mail)
Phone: Area 814, 342-4210

B154 WHITE DEERE 17887
Cleveland Brothers Equipment Co., Inc.
Old Route 15 (Shipping)
P.O. Box 139 (Mail)
Phone: Area 717, 538-2551

B153 WILKES-BARRE 18703
Cleveland Brothers Equipment Co., Inc.
Route 309 near Blackman Street—Shipping
P.O. Box 1132 (Mail)
Phone: Area 717, 822-8141

B190 BENSALEM 19020
Giles & Ransome, Inc.
2975 Galloway Road
(Mail & Shipments)
Phone: Area 215, 639-4300
Telex: 510-667-1554

B192 FOGELSVILLE 18051
Giles & Ransome, Inc.
Mail Address:
P.O. Box 2265—Allentown—ZIP 18001
Shipments: Route 22 & Snowdrift Road—
Fogelsville—ZIP 18051
Phone: Area 215, 395-0321
Branch:
Bear, Delaware

RHODE ISLAND

See Hopkinton, Massachusetts, Dealer

SOUTH CAROLINA

D210 COLUMBIA 29202
Jeff Hunt Machinery Company
3151 Charleston Highway W. Columbia—
Zip 29169
P.O. Box 328
Phone: Area 803, 794-1451

D211 SUMMERVILLE 29483 (Charleston)
Jeff Hunt Machinery Company
Frontage Road I-26, Exit 17A
P.O. Drawer 1330
Phone: Area 803, 871-2000

D212 GREENVILLE 29606
Jeff Hunt Machinery Company
Neely Ferry Road, Rte. 3
Simpsonville 29681
P.O. Box 5095, Station B
Phone: Area 803, 271-9760 (Greenville)
Area 803, 963-3645 (Simpsonville)

SOUTH DAKOTA

E210 SIOUX FALLS 57101
Kearns Machinery Co.
3201 No. Louise Ave.
Exit 81 N. Highway I-29
P.O. Box 1307
Phone: Area 605, 336-3010

E211 ABERDEEN 57401
Kearns Machinery Co.
Highway 12 East
P.O. Box 36
Phone: Area 605, 225-6240

E212 RAPID CITY 57709
Kearns Machinery Co.
417 Pine Avenue
P.O. Box 2070—57701
Phone: Area 605, 342-4850

TENNESSEE

D390 KNOXVILLE 37914
Stowers Machinery Corporation
6301 Rutledge Pike
P.O. Box 6030
Phone: Area 615, 546-1414

D391 CHATTANOOGA 37401
Stowers Machinery Corporation
4066 South Access Road
P.O. Box 70
Phone: Area 615, 698-6943

B392 JOHNSON CITY 37601
Stowers Machinery Corporation
2908 Oakland Avenue
P.O. Box 3460, CRS
Phone: Area 615, 282-2000

TENNESSEE (Continued)

D460 MEMPHIS 38116
Taylor Machinery Company
1291 Corporate Avenue
P.O. Box 16992
Phone: Area 901, 332-3051
Telex: 5-3963
Branches:
Clarksdale, Miss.
Tupelo, Miss.

D463 MEMPHIS 38116
Taylor Machinery Company
Truck Engine Dept.
1289 Corporate Avenue
Phone: Area 901, 332-3051

D420 NASHVILLE 37086
Thompson & Green Machinery Co., Inc.
1245 Firestone Boulevard—
(Lavergne 37086)
Phone: Area 615, 793-6861

TEXAS

E090 DALLAS 75220
Darr Equipment Co.
2000 Airport Freeway East—Irving
75062
P.O. Box 20737 (Mail)
Phone: Area 214, 579-2000)
Telex: 73-2396
Metro No.: 445-0060

E091 LONGVIEW 75602
Darr Equipment Co.
Farm Road 1845
P.O. Box 7070
Phone: Area 214, 758-6175

E094 TEXARKANA 75501
Darr Equipment Co.
2712 W. Seventh Street
P.O. Box 1901 (Mail)
Phone: Area 214, 793-5582

E092 WACO 76703
Darr Equipment Co.
1700 West Loop 340W—Zip 76710
P.O. Box 2411
Phone: Area 817, 662-4911

E093 WICHITA FALLS 76307
Darr Equipment Co.
1909 Jacksboro Highway—Zip 76301
P.O. Box 1151
Phone: Area 817, 767-4384

E190 CORPUS CHRISTI 78403
B.D. Holt Co.
1325 S. Padre Island Dr.
P.O. Box 1979
Phone: Area 512, 853-9933
Telex: 767-544

TEXAS (Continued)

E194 ARANSAS PASS 78336
B.D. Holt Co.
Shrimp Basin
281 Bieglow
P.O. Drawer T
Phone: Area 512, 758-3288

E192 BROWNSVILLE 78520
B.D. Holt Co.
Shrimp Turning Basin
Star Route, Box 22
Phone: Area 512, 831-9336

E193 VICTORIA 77901
B.D. Holt Co.
99001 Holt Road
P.O. Box 3454
Phone: Area 512, 573-2438

E191 WESLACO 78596
B.D. Holt Co.
E. State Highway
P.O. Box 3043
Phone: Area 512, 968-2161

E200 SAN ANTONIO 78293
Holt Machinery Co.
Holt Avenue and W.W. White Rd.
Mail Address: P.O. Box 658
Phone: Area 512, 648-1111
Telex: 76-7444

E201 AUSTIN 78767
Holt Machinery Co.
9601 S. Interregional Highway
P.O. Box 1604
Phone: Area 512, 282-2011

E202 LAREDO 78041
Holt Machinery Co.
Old Mines Road (FM 1472) }—Shipping
Route 1, Box 290
P.O. Box 3347—Mail
Phone: Area 512, 722-0075

E300 HOUSTON 77001
Mustang Tractor & Equipment Company
12800 Northwest Freeway
P.O. Box 1373
Phone: Area 713, 460-2000
TWX: 910-881-3624 (Answer Back:
Mustang 1-Hou)

E310 HOUSTON 77001
(e) Mustang Power Products, Inc.
7777 Washington Avenue
P.O. Box 3455
Phone: Area 713, 868-6700
Telex: 76-2188
Answer Back "CAT-POWER-HOU"
TWX: 910-881-3624
Answer Back Mustang 1 Hou
Tele-Quip, dial 713-460-2000. ext. 276

TEXAS (Continued)

E303 BEAUMONT 77706
Mustang Tractor & Equipment Company
7990 Eastex Freeway
P.O. Box 5383
Phone: Area 713, 892-8412

E301 EL CAMPO 77437
Mustang Tractor & Equipment Company
Hwy. 71 North
P.O. Box 48
Phone: Area 713, 543-3389

E302 LUFKIN 75901
Mustang Tractor & Equipment Company
U.S. Hwy. 69 S.E.
P.O. Box 1703
Phone: Area 713, 632-5565

E352 EL PASO 79914
Rust Tractor
10501 Dyer St.—79924
P.O. Box 4827
Phone: Area 915, 821-7651
Mail Office:
Albuquerque, New Mexico
Branches:
Farmington, New Mexico
Hobbs, New Mexico

E440 ABILENE 79602
Treanor Equipment Company
3601 So. Treadaway Blvd.
Phone: Area 915, 692-1600

E441 ODESSA 79763
Treanor Equipment Company
815 West Murphy
Phone: Area 915, 337-5521

E443 ODESSA 79663
(e) Treanor Equipment Co.
2301 Production
Phone: Area 915, 332-1681

E470 AMARILLO 79120
West Texas Equipment Company
I-40 E. & FM 1912
Mail Address: P.O. Box 31360
Phone: Area 806, 335-1511
Telex: 73-84444

E471 LUBBOCK 79408
West Texas Equipment Company
702 Slaton Road East
Mail Address: P.O. Box 369
Phone: Area 806, 745-4495
Telex: 74-4430

UTAH

E480 SALT LAKE CITY 84115
Wheeler Machinery Co.
330 West 2100 South
Phone: Area 801, 487-7811

VERMONT

B251 MONTPELIER 05602
Jordan-Milton Machinery, Inc.
Northfield Road, Route 12
P.O. Box 429 (Mail)
Phone: Area 802, 223-2356
Mail Office:
Concord, N.H.

VIRGINIA

B013 SPRINGFIELD 22150
Alban Tractor Co., Inc.
7940 Alban Road
I-95 at Fort Belvoir-Newington Exit
P.O. Box 646 (Mail)
Phone: Area 703, 451-8410
Mail Office:
Baltimore, Md.
Branches:
Myersville, Maryland
Salisbury, Maryland

D100 SALEM 24153
Carter Machinery Company, Inc.
1330 Lynchburg Turnpike
Mail Address: P.O. Box 1096
Phone: Area 703, 387-1111
Telex: 82-9311

D102 NORTON 24273
Carter Machinery Company, Inc.
310 Kentucky Ave.
P.O. Box 349
Phone: Area 703, 679-1010

D104 OAKWOOD 24631
Carter Machinery Company, Inc.
Rte. 460
P.O. Box 356 (Mail)
Phone: Area 703, 498-4586
Branches:
Bluefield, West Virginia
Lewisburg, West Virginia

D450 RICHMOND 23261
Virginia Tractor Co., Inc.
1901 Westwood Ave. (Shipping Address)
P.O. Box 27306
Phone: Area 804, 353-2701
Telex: 828348

D451 CHESAPEAKE 23320
Virginia Tractor Co., Inc.
1712 S. Military Highway
(Shipping Address)
P.O. Box 1547
Phone: Area 804, 424-1444

D452 FISHERVILLE 22980
Virginia Tractor Co., Inc.
Routes 250 and 608 (Shipments only)
P.O. Box 908 (Mailing Address)
Waynesboro, Virginia 22980
Phone: Area 703, 942-8111

VIRGINIA (Continued)

D453 HAYMARKET 22069
Virginia Tractor Co., Inc.
15151 Washington Street
P.O. Box 42
Phone: Area 703, 754-7195

D454 RICHMOND 23261
(e) Power Systems and Controls
Subsidiary of Virginia Tractor Co., Inc
3206 Landale Ave.—23230
P.O. Box 27306—23261
Phone: Area 804, 355-2803

WASHINGTON

H600 COLFAX 99111
(A) Arrow Industries, Inc.
Highway 195, 5 miles North of Colfax
P.O. Box 70
Phone: Area 509, 397-4377

H604 ST. JOHN 99171
Arrow Equipment Co.
Main Street
P.O. Box 238
Phone: Area 509, 648-3344

H601 LACROSSE 99143
(A) B.E.K. Machinery Co.
W/S Main Street
P.O. Box 48
Phone: Area 509, 549-3557

H030 SPOKANE 99206
Bower Machinery Company, Inc.
E. 4625 Trent Avenue
Terminal Box 2807 (Mail) (ZIP: 99220)
Phone: Area 509, 535-1744

H607 TEKOA 99033
(A) Cash Hardware Co., Inc.
S. 102 Ramsey Highway 274 (Shipping)
P.O. Box 370
Phone: Area 509, 284-2501
Telex: 509-284-6161

H609 FAIRFIELD 99012
(A) Cornwall Machinery Co.
1st & Hamilton
P.O. Box 335
Phone: Area 509, 283-2212 or
Area 509, 291-4221

H612 POMEROY 99347
(A) General Tractor & Implement Co.
1919 East Main—Shipping
P.O. Box 306
Phone: Area 509, 843-1691

WASHINGTON (Continued)

H182 LONGVIEW 98632
Halton Tractor Co.
1205 Baltimore Street
P.O. Box 546
Phone: Area 206, 423-5760
Main Office:
Portland, Oregon
Branches:
The Dalles, Oregon
Salem, Oregon

H250 YAKIMA 98907
Inland Machinery Co.
2100 Terrace Heights Drive (Shipping)
Mail Address: P.O. Box 1669
Phone: Area 509, 248-2371

H251 PASCO 99301
Inland Machinery Co.
1907 E. James Street (Shipping)
P. O. Box 2467
Phone: Area 509, 547-9541

H252 WALLA WALLA 99362
Inland Machinery Co.
102 E. Poplar Street (Shipping)
P.O. Box 1667
Phone: Area 509, 525-4740
Branch:
Pendleton, Oregon

H330 SEATTLE 98124
*N C Machinery Co.
Corporate Offices
2715 East Marginal Way South
(Pier 28) Zip 98134
P.O. Box 3562—Mail
Seattle, Washington 98124
Phone: Area 206, 583-8700
Telex: 32-1245
Shipments to:
17025 West Valley Highway
P.O. Box 88786
Seattle, Washington 98188 (Tukwila)
Phone: Area 206, 251-5800

H334 CHEHALIS 98532
*N C Machinery Co.
1178 Northwest Maryland Avenue
P.O. Box 712
Phone: Area 206, 748-8845

H333 MOUNT VERNON 98273
*N C Machinery Co.
2020 Freeway Drive
P.O. Box 130
Phone: Area 206, 424-4292

WASHINGTON (Continued)

H331 SEATTLE 98109
*(e) N C Marine
2500 Westlake Avenue North
Phone: Area 206, 282-6800
Telex: 32-0352
Branches:
Anchorage, Alaska
Fairbanks, Alaska
Juneau, Alaska
Ketchikan, Alaska
*Division of Northern Commercial Company

H633 ODESSA 99159
(A) Wenz Tractor and Implement Company
8 South Division
P.O. Box 217
Phone: Area 509, 982-2542

WEST VIRGINIA

B094 BRIDGEPORT 26330
Beckwith Machinery Co.
P.O. Box 570 (Mail)
Route 76 (Shipping)
Phone: Area 304, 623-2981
Teletype: 710-939-6804

D101 BLUEFIELD 24701
Carter Machinery Company, Inc.
Route 52 North
P.O. Box 1538
Phone: Area 304, 325-5411

D103 LEWISBURG 24901
Carter Machinery Company, Inc.
Rt. 60 West
Rt. 5, Box 23
Phone: Area 304, 645-6440
Main Office:
Salem, Virginia
Branches:
Norton, Virginia
Oakwood, Virginia

D470 CHARLESTON 25329
Cecil I. Walker Machinery Co.
Route 60 East (Belle, W. Va.) ZIP 25015
P.O. Box 2427 (Mail)
Phone: Area 304, 949-6400
Telex: 885-430

D473 BECKLEY 25801
Cecil I. Walker Machinery Co.
1149 Valley Drive, North
P.O. Box 1640
Phone: Area 304, 253-2706

D471 PARKERSBURG 26101
Cecil I. Walker Machinery Co.
4010 Emerson Avenue
P.O. Box 4128 (Mail)
Phone: Area 304, 485-4547

D475 SUMMERSVILLE 26651
Cecil I. Walker Machinery Co.
815 Main Street
P.O. Drawer D
Phone: Area 304, 872-4303

WISCONSIN

B260 GREEN BAY 54306
Kramer Machinery Inc.
600 Hansen Rd. (Highway 41)—54304
P.O. Box 2447
Phone: Area 414, 499-0611
Branch:
Marquette, Michigan

B310 MADISON 53715
Nagle-Hart Inc.
1111 Applegate Road—Zip 53713—Shipping
P.O. Box 9040—Mail
Phone: Area 608, 271-6200

B311 EAU CLAIRE 54701
Nagle-Hart Inc.
1211 Menomonie Street—
Shipping and Mailing
Phone: Area 715, 832-6647

B312 MILWAUKEE 53225
Nagle-Hart Inc.
11200 W. Silver Spring Road—
Shipping and Mailing
Phone: Area 414, 461-9100

WYOMING

E490 CASPER 82602
Wyoming Machinery Company
5050 Old Yellowstone Highway—Zip 82601
P.O. Box 2335
Phone: Area 307, 265-1000

E491 CHEYENNE 82001
Wyoming Machinery Company
1700 Ringsby Road
P.O. Box 987
Phone: Area 307, 634-1561

PARTS DEPARTMENTS

Caterpillar Tractor Co.
P.O. Box 16023
Denver, Colorado 80216

Caterpillar Tractor Co.
P.O. Box 339
Morton, Illinois 61550

Caterpillar Tractor Co.
P.O. Box 18610
Memphis, Tennessee 38118

Caterpillar Tractor Co.
P.O. Box 787
York, Pennsylvania 17405

PARTS DEPOTS

CALIFORNIA

LOS ANGELES 90040
Caterpillar Tractor Co.
2110 S. Davie Ave.
Phone: Area 213, 726-6777
Telex: 677-164

HAYWARD 94540
Caterpillar Tractor Co.
P.O. Box 4235—Mail—ZIP 94540
25972 Eden Landing Road—Zip 94545
Phone: Area 415, 783-2553

FLORIDA

MIAMI LAKES 33014
Caterpillar Tractor Co.
15550 N.W. 59th Ave.
P.O. Box 4850
Phone: Area 305, 557-3180
Telex: 519-288

GEORGIA

ATLANTA 30325
Caterpillar Tractor Co.
1259 Seaboard Industrial Blvd. N.W.
Mail Address: Station N., Box 19776—Zip 30325
Phone: Area 404, 351-6160-1-2

INDIANA

INDIANAPOLIS 46241
Caterpillar Tractor Co.
2000 Executive Drive, Park Fletcher
Mail Address: P.O. Box 41314
Phone: Area 317, 244-6831-2

LOUISIANA

NEW ORLEANS 70183
Caterpillar Tractor Co.
801 Edwards Avenue
Harahan Industrial Development—Zip 70123
P.O. Box 23218—ZIP 70183
Phone: Area 504, 733-7047-8-9
Telex: 58-7400

MINNESOTA

ROSEVILLE 55113
Caterpillar Tractor Co.
1901 West County Road B2
Phone: Area 612, 636-1444-5-6

MISSOURI

KANSAS CITY North 64117
Caterpillar Tractor Co.
3512 N.E. 33rd Terrace
Phone: Area 816, 453-6302

NEW YORK

ALBANY 12205
Caterpillar Tractor Co. (Inc.)
37 Warehouse Row
Phone: Area 518, 459-3030-31-32

TEXAS

DALLAS 75062
Caterpillar Tractor Co.
2300 Carl Road
Irving, Texas 75062
Phone: Area 214, 438-1424
Telex: 073-2377

WASHINGTON

SPOKANE 99220
Caterpillar Tractor Co.
6811 E. Mission Ave.
Mail Address: P.O. Box 2506—Terminal Annex
Phone: Area 509, 924-5700-1-2

ALPHABETICAL LIST OF DEALERS
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D350—Ring Power Corporation, Jacksonville, Florida	4
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*N C Machinery Co. and N C Marine are trade names used by this dealer for operations in the States of Alaska and Washington.

CATERPILLAR DEALERS
OUTSIDE THE U.S.A.

CATERPILLAR TRACTOR CO.
CATERPILLAR AMERICAS CO.
CATERPILLAR OF AUSTRALIA LTD.
CATERPILLAR BRASIL S. A.
CATERPILLAR FAR EAST LTD.
CATERPILLAR MITSUBISHI LTD.
CATERPILLAR TRACTOR CO. LTD.
CATERPILLAR OVERSEAS S. A.

CATERPILLAR AMERICAS CO.
PEORIA, ILLINOIS U.S.A. 61629

Caterpillar of Canada Ltd.
1550 Caterpillar Rd.
Mississauga, ON, Canada L4X 1E7
Phone: (416) 279-9901
Telex No.: 06-961149/961151 (From U.S.)

Caterpillar Brasil S.A.
04795—Av. Das Nacoes Unidas, 22.540 (S. Amaro)
Mail Address: Caixa Postal, 8239
01.000—SAO PAULO—SP—BRAZIL
Phones: 247-1011/5919/1100
Cable Address: CATERPILAR SP, BRAZIL
Telex No.: 391-01122824
391-01121496

Caterpillar Brasil S.A.
Caixa Postal 330
CEP 13400
Piracicaba, SP, Brazil

Caterpillar Brasil S.A.
SBS—Edificio Casa de Sao Paulo
Office No. 901/902
70.000 Brasilia, D.F., Brazil
Telephone: 23-0446 or 26-0843
Telex No.: 611282

Caterpillar Mexicana S.A. de C.V.
P.O. Box 2781
Monterrey, N.L., Mexico
Phones: 46-45-32/33/34/35
Telex No.: 038-794 (From U.S.)

ARGENTINA

R430 BUENOS AIRES
(INC LT) MACROSA Crothers Maquinarias
S.A.C.I.F.
Avda. Fondo de la Legua 1232
Martinez (Partido San Isidro)
Mail Address: Casilla de Correo 693
Correo Central
Phones: 792-0021 through 29
Cable Address: MACROSA BAIRES
Telex No.: 012-1739

R434 COMODORO RIVADAVIA, CHUBUT
MACROSA Crothers Maquinarias
S.A.C.I.F.
Alvear 347
Phone: 2324
Telex No.: 015-741

R431 CORDOBA
MACROSA Crothers Maquinarias
S.A.C.I.F.
Avda. Pueyrredon 154/6
Phone: 26-332
Telex No.: 046-865

R432 MENDOZA
MACROSA Crothers Maquinarias
S.A.C.I.F.
Carril Rodriguez Pena y Urquiza
Zona Industrial Mendoza
5501- Godoy Cruz, Mendoza
Phones: 22-0241/4373
Telex No.: 043-815

R438 NEUQUEN
MACROSA Crothers Maquinarias
S.A.C.I.F.
Intendente Linares, esq. Felix San Martin
Phone: 2693
Telex No.: 015-842

ARGENTINA (Cont.)

R437 POSADAS, MISIONES
MACROSA Crothers Maquinarias
S.A.C.I.F.
Avda. Arechea esq. Mendoza
Phone: 7084

R433 SALTA
MACROSA Crothers Maquinarias
S.A.C.I.F.
12 de Octubre 793
Phones: 17996, 14127
Telex No.: 044-883

R435 TUCUMAN
MACROSA Crothers Maquinarias
S.A.C.I.F.
Avda. General San Martin 102
Banda del Rio Sali
Phone: 21250
Telex No.: 044-880

BAHAMAS

P070 NASSAU
(INC LT) Atlantic Equipment & Power Ltd.
P.O. Box N-3238
Cable Address: ATLANTIC
Phone: (809) 323-5701
Telex No.: NS125

P071 FREEPORT, GRAND BAHAMA ISLAND
Atlantic Equipment & Power Ltd.
P.O. Box F-128
Phone (809) 352-6646

BOLIVIA

R180 LA PAZ
(INC LT) International Machinery Co.
(Bolivia)
S.A.
1075 Calle Mercado
Mail Address: Casilla 852
Phones: 40972, 53787
Cable Address: INTERMACO LA PAZ
Telex No.: 5227

R181 COCHABAMBA
International Machinery Co. (Bolivia) S.A.
Casilla 495
Phone: 24702

ORURO
International Machinery Co. (Bolivia) S.A.
Casilla 106
Phone: 50323

POTOSI
International Machinery Co. (Bolivia) S.A.
Casilla 156
Phone: 2051

R182 SANTA CRUZ
International Machinery Co. (Bolivia) S.A.
Casilla 83
Phones: 24223, 33957

SUCRE
International Machinery Co. (Bolivia) S.A.
Casilla 48
Phone: 1132

BRAZIL

BAHEMA

U020 40.000 SALVADOR—BAHIA
BAHEMA S.A. Tratores e Máquinas
Km. 0 da Rodovia BR—324 (Retiro)
Mail Address: Caixa Postal, 1370
Phones: 244-4855, 244-4034, 244-4434,
244-4234
Cable Address: BAHENGI
SALVADOR,
BAHIA, BRASIL
Telex No.: 071-1392—071-1314

49.000 ARACAJÚ—SERGIPE
BAHEMA S.A. Tratores e Máquinas
Km. 3 da BR—235
Mail Address: Caixa Postal, 262
Phones: 222-8277, 222-8637
Cable Address: BAHENGI ARACAJÚ,
SERGIPE, BRASIL
Telex No.: 079-2132

45.600 ITABUNA—BAHIA
BAHEMA S.A. Tratores e Máquinas
Av. Ibicarai, 858—Bairro Juca Leão
Phone: 6-800
Cable Address: BAHENGI
FIBUNA, ITABUNA,
BAHIA, BRASIL
Telex No.: 073-2142

BRAZIL (Cont.)

CITREQ

U230 66.000 BELÉM—PARÁ
Companhia Importadora de Tratores e
Equipamentos—CITREQ
Av. Almirante Barroso, 3864
Mail Address: Caixa Postal, 358
Phones: 226-0012, 226-0426,
226-0622, 226-0212
Cable Address: CITREQ BELÉM,
PARÁ, BRASIL
Telex No.: 091-1021

U231 65.000 SÃO LUIS—MARANHÃO
Companhia Importadora de Tratores e
Equipamentos—CITREQ
Av. Santos Dumont, 380
Mail Address: Caixa Postal, 502
Phone: 2-2113
Cable Address: CITREQ SÃO LUIS,
MARANHÃO, BRASIL
Telex No.: 098-2184

U232 64.000 TERESINA—PIAUÍ
Companhia Importadora e Tratores e
Equipamentos—CITREQ
Av. Barão de Gurgueia, 2696—S
Mail Address: Caixa Postal, 355
Phone: 222-8912
Cable Address: CITREQ TERESINA,
PIAUÍ, BRASIL
Telex No.: 086-2148

69.900 MAÇAPÁ—
TERRITÓRIO FEDERAL DO AMAPÁ
Companhia Importadora de Tratores e
Equipamentos—CITREQ
Av. Duque de Caxias, S/nº.
Phone: 2251
Cable Address: CITREQ—MACAPÁ
TERRITÓRIO
FEDERAL
DO AMAPÁ, BRASIL

U233 69.000 MANAUS—AMAZONAS
Companhia Importadora de Tratores e
Equipamentos—CITREQ
Rodovia Torquato Tapajós, 3280 (Km. 4)
Mail Address: Caixa Postal, 578
Phone: 32-6924
Cable Address: CITREQ MANAUS
AMAZONAS, BRASIL
Telex No.: 092-2264

U234 78.900 PORTO VELHO—
TERRITÓRIO FEDERAL
DE RONDÔNIA
Companhia Importadora de Tratores e
Equipamentos—CITREQ
Rua Dom Pedro II, 1190
Mail Address: Caixa Postal, 8
Phone: 2310, 2289, 2344
Cable Address: CITREQ PORTO
VELHO TERRITÓRIO
FEDERAL DE
RONDÔNIA, BRASIL
Telex No.: 069-2121

BRAZIL (Cont.)

FIGUERAS

U090 90.000 PORTO ALEGRE—RS
Figueras S.A. Engenharia e Importação
Av. Assis Brasil, 164
Mail Address: Caixa Postal, 245
Phones: 42-4877, 42-4078,
42-4678, 42-4576
Cable Address: FIGERSA P.
ALEGRE, RIO
GRANDE DO
SUL, BRASIL
Telex No.: 051-1252

89.100 BLUMENAU—SANTA CATARINA
Figueras S.A. Engenharia e Importação
Rua São Paulo, 2711
Mail Address: Caixa Postal, 819
Phone: 22-4588, 22-4378
Cable Address: FIGERSA—
BLUMENAU SANTA
CATARINA, BRASIL
Telex No.: 047-3178

96.500 CACHOEIRA DO SUL—RS
Rua Marcílio Dias, 767
Mail Address: Caixa Postal, 182
Phone: 22-2450, 22-2550
Cable Address: FIGERSA
CACHOEIRA DO SUL,
RS, BRASIL
Telex No.: (051) 1795

U100 96.100 PELOTAS—RS
Rua Princesa Isabel, 207/211
Mail Address: Caixa Postal, 315
Phone: 22-7065, 22-1366, 22-5368
Cable Address: FIGERSA PELOTAS,
RIO GRANDE
DO SUL, BRASIL
Telex No.: 053-2154

97.500 URUGUAIANA—RS
Figueras S.A. Engenharia e Importação
Rua Duque de Caxias, 2757
Mail Address: Caixa Postal, 90
Phone: 412-1870, 412-1613
Cable Address: FIGERSA
URUGUAIANA, RIO
GRANDE DO
SUL, BRASIL
Telex No.: 055-2167

89.800 CHAPECÓ—SC
Figueras S.A. Engenharia e Importação
Rodovia SC-22--K.4
Bairro Efapi
Phone: 22-0857
Cable Address: FIGERSA CHAPECÓ
SANTA
CATARINA, BRASIL
Telex No.: 047-3313

U091 88.000 FLORIANÓPOLIS—SC
Figueras S.A. Engenharia e Importação
Rua Felipe Schmidt 58—Gal.
Comasa—L/8
Phone: 22-5036
Cable Address: FIGERSA
FLORIANÓPOLIS
SANTA
CATARINA, BRASIL

BRAZIL (Cont.)

LION

U130 01.000 SÃO PAULO—SP
Lion S.A. Engenharia e Importação
Praça 9 de Julho, 100
Mail Address: Caixa Postal, 44
Phones: 278-0211, 278-1666
Cable Address: LIONN SÃO PAULO,
SÃO PAULO, BRASIL
Telex No.: 24-230, 21-184/
21-786 (Parts)

16.900 ANDRADINA—SÃO PAULO
Lion S.A. Engenharia e Importação
Rua Paes Leme, 1039
Mail Address: Caixa Postal, 95
Phones: 22-3151, 22-3152, 22-3153
Cable Address: LIONFILIAL
ANDRADINA, SÃO
PAULO, BRASIL

U132 17.100 BAURÚ—SÃO PAULO
Lion S.A. Engenharia e Importação
Rua Cel. Gustavo Macial, 6-26
Mail Address: Caixa Postal, 25
Phone: 2-6654
Cable Address: LIONFILIAL
BAURÚ, SÃO
PAULO, BRASIL
Telex No.: 014-2134

14.100 RIBEIRÃO PRETO—SÃO PAULO
Lion S.A. Engenharia e Importação
Rua Henrique Dumont, 1465
Mail Address: Caixa Postal, 502
Phone: 25-2565
Cable Address: LIONFILIAL
RIBEIRÃO PRETO
SÃO PAULO, BRASIL
Telex No.: 016-6174

11.100 SANTOS—SÃO PAULO
Lion S.A. Engenharia e Importação
Av. Dr. Waldemar Leão, 70
Mail Address: Caixa Postal, 80
Phone: 32-4233
Cable Address:
LIONFILIAL SANTOS, SÃO
PAULO, BRASIL
Telex No.: 013-1141

15.100 SÃO JOSÉ DO RIO PRETO—
SÃO PAULO
Lion S.A. Engenharia e Importação
Av. Tarraf, 2710
Mail Address: Caixa Postal, 576
Phone: 32-8111
Cable Address:
LIONFILIAL—SÃO JOSÉ DO
RIO PRETO
SÃO PAULO, BRASIL
Telex No.: 0172-103

U131 79.100 CAMPO GRANDE—
MATO GROSSO
Lion S.A. Engenharia e Importação
Rua 7 de Setembro, 234
Mail Address: Caixa Postal, 441 (MT)
Phone: 4-4424
Cable Address: LIONFILIAL
CAMPO GRANDE,
MATO
GROSSO, BRASIL
Telex No.: 067-2134

BRAZIL (Cont.)

78.000 CUIABÁ—MATO GROSSO
Lion S.A. Engenharia e Importação
Av. Perimetral, s/n
Bairro Pico do Amor
Mail Address: Caixa Postal, 1145
Phones: 2074, 2926, 3832
Cable Address: LIONFILIAL
CUIABÁ, MATO
GROSSO, BRASIL
Telex No.: 065-2120

13.100 CAMPINAS—SÃO PAULO
Lion S.A. Engenharia e Importação
Av. Orozimbo Maia, 1062
Mail Address: Caixa Postal, 1650
Phone: 51-2555
Cable Address: LIONFILIAL
CAMPINAS, SÃO
PAULO, BRASIL
Telex No.: 019-1064

19.100 PRESIDENTE PRUDENTE—
SÃO PAULO
Lion S.A. Engenharia e Importação
Av. Manoel Goulart, 1655
Vila Charlotte
Mail Address: Caixa Postal, 614
Phone: 3-2822
Cable Address: LIONFILIAL
PRESIDENTE
PRUDENTE
SÃO PAULO, BRASIL
Telex No.: 182-112

12.200 SÃO JOSÉ DOS CAMPOS—
SÃO PAULO
Lion S.A. Engenharia e Importação
Av. Dinamarca, 225
Mail Address: Caixa Postal, 1037
Phone: 21-6800
Cable Address: LIONFILIAL
SÃO JOSÉ
DOS CAMPOS
SÃO PAULO, BRASIL
Telex No.: 25-111

MARCOSA

U150 60.000 FORTALEZA—CEARÁ
Marcosa S.A. Máquinas e
Equipamentos
Rua Dr. João Moreira, 359—Altos
Mail Address: Caixa Postal, 538
Phones: 231-1088, 227-0800,
227-0802, 227-5588
Pres.: 231-1219
V. Pres.: 231-1540
Cable Address: CEMARCOSA
FORTALEZA,
CEARÁ, BRASIL
Telex No.: 085-1166

58.000 JOÃO PESSOA—PARAÍBA
Marcosa S.A. Máquinas e Equipamentos
BR-101, nº. 235—Distrito Industrial
Mail Address: Caixa Postal, 191
Phone: 221-0310
Cable Address: JOMARCOSA
JOÃO PESSOA,
PARAÍBA, BRASIL
Telex No.: 083-2121

BRAZIL (Cont.)

59.000 NATAL—
RIO GRANDE DO NORTE
Marcosa S.A. Máquinas e Equipamentos
Travessa das Donzelas, 311 (Rocas)
Mail Address: Caixa Postal, 317
Phones: 2-0737, 2-4686
Cable Address: NORMARCOSA NATAL,
RIO GRANDE
DO NORTE, BRASIL

AMORIM

U010 50.000 RECIFE—PERNAMBUCO
Oscar Amorim, Comércio S.A.
Rua Imperial, 1600
Mail Address: Caixa Postal, 564
Phone: 231-0222
Cable Address: AMORINS RECIFE,
PERNAMBUCO
BRASIL
Telex No.: 081-1045

57.000 MACEIÓ—ALAGOAS
Oscar Amorim, Comércio S.A.
Rua Barão do Jaraguá, 456/462
Mail Address: Caixa Postal, 50
Phone: 223-2135
Cable Address: AMORINS MACEIÓ,
ALAGOAS,
BRASIL
Telex No.: 082-2171

PARANÁ

U170 80.000 CURITIBA—PARANÁ
Paraná Equipamentos S.A.
Rodovia Regis Bittencourt,
BR-116, Km. 404
Mail Address: Caixa Postal, 929
Phone: 76-1011
Cable Address: EQUIPAMENTO
CURITIBA,
PARANÁ, BRASIL
Telex No.: 041-5195, 041-5020

U172 85.800 CASCAVEL—PARANÁ
Paraná Equipamentos S.A.
Rodovia Federal (BR-277)—Km. 400
Mail Address: Caixa Postal, 122
Phones: 23-1647, 23-0722
Cable Address: EQUIPAMENTO
CASCAVEL,
PARANÁ, BRASIL

U171 86.100 LONDRINA—PARANÁ
Paraná Equipamentos S.A.
Rodovia Londrina—Cambé (BR-369)
Jardim Jockey Club
Mail Address: Caixa Postal, 1614
Phones: 27-2044, 27-2711, 27-2843
Cable Address: LAGARTO
LONDRINA,
PARANÁ, BRASIL
Telex No.: 043-2169

BRAZIL (Cont.)

SOTREQ

U190 20.000 RIO DE JANEIRO—
RIO DE JANEIRO
Sotreq S.A. de Tratores e
Equipamentos
Av. Brasil, 7200
Mail Address: Caixa Postal, 20
Phone: 270-4712, 270-5236, 270-0036
Cable Address: SOTREQ—RIO
DE JANEIRO,
RIO DE JANEIRO,
BRASIL
Telex No.: 021-21973/21608

29.000 VITÓRIA—ESPÍRITO SANTO
Sotreq S.A. de Tratores e Equipamentos
Av. Vitória, 2518
Mail Address: Caixa Postal, 483
Phones: 23-4311, 23-3763, 23-4372
Cable Address: SOTREQ—
VITÓRIA ESPÍRITO
SANTO, BRASIL
Telex No.: 027-2153

30.000 BELO HORIZONTE—
MINAS GERAIS
Sotreq S.A. de Tratores e Equipamentos
Rua Prof. Jerson Martins, 166
Pampulha
Mail Address: Caixa Postal, 858
Phone: 441-2822, 441-4755
Cable Address: SOTREQMINAS
B. HORIZONTE,
MINAS GERAIS,
BRASIL
Telex No.: 031-1388

U212 38.400 UBERLÂNDIA—MINAS GERAIS
Sotreq S.A. de Tratores e Equipamentos
Av. Vasconcelos Costa, 1646
Mail Address: Caixa Postal, 370
Phones: 234-3309, 234-7918, 234-5287
Cable Address: SOTREQ—
UBERLÂNDIA M.
GERAIS, BRASIL
Telex No.: 034-3176

74.000 GOIÂNIA—GOIÁS
Sotreq S.A. de Tratores e Equipamentos
Av. Meia Ponte, 3080
Bairro de Sta. Genoveva
Mail Address: Caixa Postal, 312
Phone: 225-2522
Cable Address: SOTREQ—
GOIÂNIA GOIÁS,
BRASIL
Telex No.: 062-2134

U211 70.000 BRASÍLIA—DISTRITO FEDERAL
Sotreq S.A. de Tratores e Equipamentos
Setor Industrial A, Bloco 2, Lote 510
Phones: 233-3145, 233-1432, 233-0148
Cable Address: SOTREQ—
BRASÍLIA DISTRITO
FEDERAL, BRASIL
Telex No.: 061-1436

BELIZE, C.A.

P090 BELIZE CITY
R. H. Eyles & Sons Ltd.
North Front Street
Mail Address: P. O. Box 8
Cable Address: EYLES, BELIZE
Phone: 2369

CANADA

N170 EDMONTON, ALBERTA T5J 2S1
(INC LT) R. Angus Alberta Limited
16900-107 Avenue
Mail Address: P. O. Box 2405
Phone: 483-3636 Area Code: 403
Telex No.: Rangusalta EDM 037-2467
(New Building) 037-3336

N171 PEACE RIVER, ALBERTA T0H 2X0
R. Angus Alberta Limited
Industrial Park
Mail Address: P. O. Box 220
Phone: 624-1550 Area Code: 403
Telex No.: 037-51527

N172 GRAND PRAIRIE, ALBERTA T8V 3J9
R. Angus Alberta Limited
11115-100 Avenue
Mail Address: P. O. Box 336
Phone: 523-8811 Area Code: 403
Telex No.: 036-7438

N173 FORT MCMURRAY, ALBERTA T0A 1K0
R. Angus Alberta Limited
P. O. Box 5663
Phone: 743-2218 Area Code: 403
Telex No.: 037-5413

N174 CALGARY, ALBERTA T2H 1W9
R. Angus Alberta Limited
4015 Eighth St. S. E.
Mail Address: Postal Station "A"
Phone: 243-2751 Area Code: 403
Telex No.: CGY 0038-22546

N175 LETHBRIDGE, ALBERTA T1J 4A4
R. Angus Alberta Limited
717 Fifth Avenue North
Mail Address: P. O. Box 1178
Phone: 328-3366 Area Code: 403
Telex No.: 038-49213

N176 RED DEER, ALBERTA T4P 1A9
R. Angus Alberta Limited
6740-67 Avenue
Mail Address: P. O. Box 525
Phone: 347-1106 Area Code: 403
Telex No.: 03-83149

N177 INUVIK, NORTHWEST
TERRITORIES X0E 0T0
R. Angus Alberta Limited
P. O. Box 1278
Phone: 979-2551 Area Code: 403
Telex No.: 034-44542

N178 HAY RIVER, NORTHWEST
TERRITORIES
X0E 0R0
R. Angus Alberta Limited
P. O. Box 1136
Phone: 874-6537 Area Code: 403
Telex No.: 034-4255

N030 VANCOUVER, BRITISH
COLUMBIA V5T 1E2
(INC LT) Finning Tractor & Equipment,
Company Limited
555 Great Northern Way
Phone: 872-7474 Area Code: 604
Telex No.: Finning VCR 04-508717

CANADA (Cont.)

N032 CRANBROOK, BRITISH
COLUMBIA V1C 3S2
Finning Tractor & Equipment Company
Limited
815 Cranbrook Street
Phone: 426-6631 Area Code: 604
Telex No.: CBK 041-45224

N033 DAWSON CREEK, BRITISH
COLUMBIA V1G 4H4
Finning Tractor & Equipment Company
Limited
P. O. Box 539
Phone: 782-5841 Area Code: 604
Telex No.: DCK 036-77147

N034 NELSON, BRITISH COLUMBIA V1L 5R3
Finning Tractor & Equipment Company
Limited
P. O. Box 510
Phone: 352-6622/3 Area Code: 604
Telex No.: NLSN 041-545

N035 PRINCE GEORGE, BRITISH
COLUMBIA V2N 2K8
Finning Tractor & Equipment Company
Limited
1100 Pacific Street
Phone: 563-0331 Area Code: 604
Telex No.: PGEO 047-8720

N036 TERRACE, BRITISH
COLUMBIA V8G 1K3
Finning Tractor & Equipment Company
Limited
4621 Keith Road
Phone: 635-7144 Area Code: 604
Telex No.: TERR 047-85595

N037 VERNON, BRITISH
COLUMBIA V1T 6M4
Finning Tractor & Equipment Company
Limited
P. O. Box 459
Phone: 545-2321 Area Code: 604
Telex No.: VRN 610-985-8320

N039 WILLIAMS LAKE, BRITISH
COLUMBIA V2G 1C9
Finning Tractor & Equipment Company
Limited
450 Mackenzie Avenue South
Phone: 392-3381 Area Code: 604
Telex No.: WMSLK 610-968-2010

N061 SPARWOOD, BRITISH
COLUMBIA V0B 2G0
Finning Tractor & Equipment Company
Limited
P. O. Box 1300
Phone: 425-6282 Area Code: 604
Telex No.: NTL 610-973-6096

N064 KAMLOOPS, BRITISH
COLUMBIA V2C 5K7
Finning Tractor & Equipment Company
Limited
P. O. Box 180
Phone: 372-9552 Area Code: 604
Telex No.: KAM 048-8276

CANADA (Cont.)

N066 WHITEHORSE, YUKON
TERRITORY Y1A 3S9
Finning Tractor & Equipment Company
Limited
143 Industrial Road
Mail Address: P. O. Box 4038
Phone: 667-6451 Area Code: 403
Telex No.: WHSE 036-8221

N067 HOUSTON, BRITISH
COLUMBIA V0J 1Z0
Finning Tractor & Equipment Company
Limited
P. O. Box 700
Phone: 845-2213 Area Code: 604
Telex No.: HSTN 610-988-9405

VICTORIA, BRITISH
COLUMBIA V8Z 1S4
Finning Tractor & Equipment Company
Limited
27 Crease Avenue
Phone: 384-4144/5 Area Code: 604
Telex No.: VIC 04-508717

CAMPBELL RIVER, BRITISH
COLUMBIA V9W 3M7
Finning Tractor & Equipment Company
Limited
1604 Willow Street
Phone: 287-7494/5 Area Code: 604
Telex No.: CMRVR 04-508717

NANAIMO, BRITISH
COLUMBIA V9S 4M8
Finning Tractor & Equipment Company
Limited
2298 McCulloch Road
Phone: 758-5237/8 Area Code: 604
Telex No.: NAN 04-508717

PORT HARDY, BRITISH
COLUMBIA V0N 2P0
Finning Tractor & Equipment Company
Limited
P. O. Box 310
Phone: 949-6121 Area Code: 604
Telex No.: 610 975-7015

CHILLIWACK, BRITISH
COLUMBIA V2P 6J4
Finning Tractor & Equipment Company
Limited
444375 Yale Road West
Mail Address: P. O. Box 362
Phone: 692-1918 Area Code: 604
Telex No.: CHWK 04-508717

N063 QUESNEL, BRITISH
COLUMBIA V2J 378
Finning Tractor & Equipment Company
Limited
P. O. Box 4610
Phone: 992-7051 Area Code: 604
Telex No.: 047-82554

N068 MACKENZIE, BRITISH
COLUMBIA V0J 2C0
Finning Tractor & Equipment Company
Limited
PGE Industrial Site
Mail Address: P. O. Box 309
Phone: 977-3216 Area Code: 604
Telex No.: 610-972-3007

CANADA (Cont.)

N082 REVELSTOKE, BRITISH
COLUMBIA V0E 2S0
Finning Tractor & Equipment Company
Limited
733 Highway 23
Mail Address: P. O. Box 1920
Phone: 837-5201 Area Code: 604
Telex No.: 610-985-8372

MANITOBA

N120 WINNIPEG, MANITOBA R3T 1L8
(INC LT) Powell Equipment Limited
1455 Buffalo Place
Phone: 453-4343 Area Code: 204
Telex No.: POWCO WPG 03-5550

N121 BRANDON, MANITOBA R7B 0R9
Powell Equipment Limited
1906 Park Avenue
Phone: 727-2418 Area Code: 204
Telex No.: 502749

N126 THOMPSON, MANITOBA R8N 1M4
Powell Equipment Limited
108 Hayes Road
Phone: 788-7004 Area Code: 204
Telex No.: 033-4520

NA90 WINNIPEG MANITOBA R3T 0M8
(LT) POWLIFT TRUCKS & SYSTEMS
100 Otter Street
Phone: 475-2720 Area Code: 204
Telex No.: 07-587886

NEW BRUNSWICK

N160 FREDERICTON,
NEW BRUNSWICK E3B 5E4
(INC LT) Tractors & Equipment (1962)
Limited
471 Smythe Street
Mail Address: P. O. Box 1326
Phone: 454-6651 Area Code: 506
Telex No.: 014-46116

NEWFOUNDLAND

N090 ST. JOHN'S, NEW
FOUNDLAND A1B 3S2
(INC LT) Newfoundland Tractor &
Equipment
Co., Ltd.
P. O. Box 8940, Station "A"
Phone: 722-5660 Area Code: 709
Telex No.: 016-4575

N091 CORNER BROOK,
NEWFOUNDLAND A2H 6E3
Newfoundland Tractor & Equipment Co.,
Ltd.
P. O. Box 430
Phone: 634-8258 Area Code: 709
Telex No.: 016-44157

CANADA (Cont.)

N092 GRAND FALLS, NEWFOUNDLAND
A2A 2J3
Newfoundland Tractor & Equipment Co.,
Ltd.
P. O. Box 100
Phone: 489-2131 Area Code: 709

N094 GOOSEBAY, LABRADOR
Newfoundland Tractor & Equipment Co.,
Ltd.
P. O. Box 510
Goosebay Airport
Phone: 896-5864 Area Code: 709
Telex No.: 016-2255

NOVA SCOTIA

N140 HALIFAX, NOVA SCOTIA B3K 5J2
(INC LT) N. S. Tractors & Equipment Ltd.
3575 Kempt Road
Mail Address: P. O. Box 1420
Phone: 455-0581 Area Code: 902
Telex No.: 019-21761

PRINCE EDWARD ISLAND

N110 CHARLOTTETOWN, PRINCE
EDWARD ISLAND C1A 7L1
(INC LT) A. Pickard Machinery (1971)
Limited
P. O. Box 545
Phone: 894-7329 Area Code: 902
Telex No.: 014-4411

ONTARIO

N020 CONCORD, ONTARIO L4K 1E2
(INC LT) Crothers Limited
One Crothers Drive, Highway 7 & Jane
Mail Address: P. O. Box 5511
Phone: 667-5511 Area Code: 416
Telex No.: TOR 06-964654

N022 STONEY CREEK, HAMILTON,
ONTARIO L8E 2P8
Crothers Limited
460 South Service Road (Const. Eq.)
Phone: 561-5901 Area Code: 416
Telex No.: 021-781

NB34 STONEY CREEK, HAMILTON,
ONTARIO L8E 3H6
(LT) Crothers Limited
180 South Service Road
Phone: 561-6771 Area Code: 416
Telex No.: 021-8428

N023 OTTAWA (HAZELDEAN),
ONTARIO K2L 1V7
Crothers Limited
5 Edgewater Street
Mail Address: P. O. Box 190
Phone: 836-5171 Area Code: 613
Telex No.: 012-3291

CANADA (Cont.)

N025 SUDBURY, ONTARIO P3A 4R9
Crothers Limited
1818 Falconbridge Road
Mail Address: P. O. Box 2184
Phone: 566-1911 Area Code: 705
Telex No.: 027-7421

N026 TIMMINS, ONTARIO P4N 7H6
Crothers Limited
24 Government Road
Mail Address: P. O. Box 1002
Phone: 264-5297 Area Code: 705
Telex No.: 02-277429

N027 LONDON, ONTARIO N6A 4C5
Crothers Limited
50 Enterprise Drive
Pond Mills Industrial Park
Phone: 681-1900 Area Code: 519
Telex No.: 024-677

NB37 LONDON, ONTARIO N6E 1P6
(LT) Crothers Limited
1044 Hargrieve Road
Phone: 681-7820 Area Code: 519

N028 SAULT STE. MARIE, ONTARIO P3A 4R9
Crothers Limited
1207 Great Northern Road
Mail Address: P. O. Box 533
Phone: 949-9300/9303/9304
Area Code: 705

ORILLIA, ONTARIO L3V 6H8
Crothers Limited
Orillia Industrial Park
Mail Address: P. O. Box 968
Phone: 325-7473 Area Code: 705
Telex No.: 02-29968

HEARST, ONTARIO P0L 1N0
Crothers Limited
Highway No. 11 East
Mail Address: P. O. Box 1810
Phone: 362-4276 Area Code: 705

NB30 MALTON, ONTARIO L4V 1B3
(LT) Crothers Lift
3210 American Drive
Phone: 678-7111 Area Code: 416
Telex No.: CROLFT MALTON 610-492-2609

N124 THUNDER BAY, ONTARIO P7C 4Y3
Powell Equipment Limited
620 Beaverhall Place
Mail Address: P. O. Box 1500
Phone: 577-5701 Area Code: 807
Telex No.: 033-213

QUEBEC

N050 MONTREAL, QUEBEC H9R 1B8
(INC LT) Hewitt Equipment Limited
5001 Trans-Canada Highway,
Pointe Claire
Mail Address: P. O. Box 1200
H9R 4R6
Phone: 697-6911 Area Code: 514
Telex No.: 058-21625

CANADA (Cont.)

N051 QUEBEC CITY, QUEBEC G01 3E0
Hewitt Equipment Limited
Parc Industriel Metropolitan de Quebec
Mail Address: P. O. Box 1125 G1K 7C4
Phone: 878-3000 Area Code: 418
Telex No.: 011-3090

N052 SEVEN ISLANDS, QUEBEC G4R 4K6
Hewitt Equipment Limited
400 Laure Boulevard
Mail Address: P. O. Box 400
Phone: 962-6691 Area Code: 418
Telex No.: 011-8473

N053 VAL D'OR, QUEBEC J9P 4P8
Hewitt Equipment Limited
400 Lamaque Boulevard
Mail Address: P. O. Box 787
Phone: 824-2783 Area Code: 819
Telex No.: 057-45545

N054 JAMES BAY, QUEBEC J0Y 2V0
Hewitt Equipment Limited
LG2 Office
Phone: 638-8381 Area Code: 819
Telex No.: 057-3515

N055 CHICOUTIMI, QUEBEC G7H 5B3
Hewitt Equipment Limited
820, Route 170
Mail Address: P. O. Box 5050
Phone: 545-1560 Area Code: 514
Telex No.: 011-36156

N056 HULL, QUEBEC J8Y 3S2
Hewitt Equipment Limited
40 Boulevard J. Adrien Robert
Phone: 770-1601 Area Code: 819
Telex No.: 053-3182

SASKATCHEWAN

N070 REGINA, SASKATCHEWAN S4P 3A8
(INC LT) Kramer Tractor Ltd.
Pasqua Street North at Highway 11
Mail Address: P. O. Box 707
Phone: 545-3311 Area Code: 306
Telex No.: 031-2221

N071 SASKATOON, SASKATCHEWAN S7K 3K4
Kramer Tractor Ltd.
3502-11th St. West
Mail Address: P. O. Box 140
Phone: 382-3550 Area Code: 306
Telex No.: 034-2284

N072 TISDALE, SASKATCHEWAN S0E 1T0
Kramer Tractor Ltd.
P. O. Box 420
Phone: 873-2613 Area Code: 306
Telex No.: 034-29143

(INC LT) Including Lift Trucks

Main offices in larger-faced type
Branches in smaller-faced type

CHILE

R120 SANTIAGO
(INC LT) Gildemeister S.A.C.
Amunategui 178
Mail Address: Casilla 99-D
Phone: 82525
Cable Address: GILDEMEIST
SANTIAGO,
CHILE
Telex Nos.: 40588, 40589

R123 ANTOFAGASTA
Gildemeister S.A.C.
Casilla 770

R121 ARICA
Gildemeister S.A.C.
Casilla 19-D

CHILLAN
Gildemeister S.A.C.
Casilla 25-D

CONCEPCION
Gildemeister S.A.C.
Casilla 38-C

R124 COQUIMBO
Gildemeister S.A.C.
Casilla 12-D

R122 IQUIQUE
Gildemeister S.A.C.
Casilla 5-D

LOS ANGELES
Gildemeister S.A.C.
Casilla 637

OSORNO
Gildemeister S.A.C.
Casilla 44-0

OVALLE
Gildemeister S.A.C.
Casilla 213

PUERTO VARAS
Gildemeister S.A.C.
Casilla 1695

R125 PUNTA ARENAS
Gildemeister S.A.C.
Casilla 21-D

RANCAGUA
Gildemeister S.A.C.
Casilla 282

SAN FERNANDO
Gildemeister S.A.C.
Casilla 141

TALCA
Gildemeister S.A.C.
Casilla 552

TEMUCO
Gildemeister S.A.C.
Casilla 29-D

VALDIVIA
Gildemeister S.A.C.
Casilla 63-D

CHILE (Cont.)

R126 VALPARAISO
Gildemeister S.A.C.
Casilla 87-V

COLOMBIA

R460 BOGOTA
(INC LT) General Electric de Colombia
S.A.
Km. 7 Carretera a Bosa
Mail Address: Apartado Aereo 3644
y 6799
Phones: 38-20-40; 38-40-20
(Machinery
Department)
Cable Address: GECOLSA BOGOTA
Telex No.: 044-704/
044-809
(Internacional)

AGUACHICA
Carrera 12 No. 3-104
Apartado Aereo 102
Phone: 05

R461 BARRANQUILLA
General Electric de Colombia S.A.
Carrera 46 No. 34-146
Mail Address: Apartado Aereo 100
or 2740
Phones: 319387, 324487,
313898, 315580
Cable Address: GECOLSA
BARRANQUILLA
Telex No.: 033352

R464 BUCARAMANGA
General Electric de Colombia S.A.
Ave. Quebrada Seca No. 33A-55
Mail Address: Apartado Aereo 401
Phone: 56243-55993-56154
Cable Address: GECOLSA
BUCARAMANGA
Telex No.: 077764

BUENAVENTURA
General Electric de Colombia S.A.
Kilometro 4 Via El Piñal, Locales Arpecol
Mail Address: Apartado Aereo 827
Phone: 2469
Cable Address: GECOLSA
BUENAVENTURA

R462 CALI
General Electric de Colombia S.A.
Kilometro 4 Carretera Cali-Yumbo
Mail Address: Apartado Aereo 36
Phones: 682101/2/3-641580
Cable Address: GECOLSA CALI
Telex No.: 055560

CARTAGENA
Urbanización Club Campestre
Sector Ceballos, Carretera A
Mamonal Carrera 56 No. 12-63
Phones: 85358-85025
Apartado Aereo 3596

COLOMBIA (Cont.)

CUCUTA
Calle 7 No. 1-60
Phone: 26242
Apartado Aereo 1064

R466 IBAGUE
General Electric de Colombia S.A.
Kilometro 3 Via Armero, Barrio El Jordan
Mail Address: Apartado Aereo 779
Phone: 33139-33322
Cable Address: GECOLSA IBAGUE
Telex No.: 047160

R463 MEDELLIN
General Electric de Colombia S.A.
Carrera 50 No. 32-182
Mail Address: Apartado Aereo 778
Phones: 350329, 320707, 321147-321267
Cable Address: GECOLSA MEDELLIN
Telex No.: 06709

NEIVA
General Electric de Colombia S.A.
Carrera 5 No. 10-80
Mail Address: Apartado Aereo 263
Phone: 23001
Cable Address: GECOLSA NEIVA
Telex No.: 049754

PEREIRA
General Electric de Colombia S.A.
Calle 17 No. 16B-09
Mail Address: Apartado Aereo 537
Phone: 42574-49955
Telex No.: 08875

R465 SINCELEJO
General Electric de Colombia S.A.
Calle 38 No. 31-527
Mail Address: Apartado Aereo 279
Phones: 21106, 20102
Cable Address: GECOLSA SINCELEJO
Telex No.: 03669

R467 VALLEDUPAR
General Electric de Colombia S.A.
Km. 1 Carretera A. Fundacion
Mail Address: Apartado Aereo 170
Phone: 4264-4171-4172
Cable Address: GECOLSA
VALLEDUPAR
Telex No.: 03060

R450 U. S. OFFICE
General Electric Company
Latin America Business Division
Machinery Sales Operation
570 Lexington Avenue
New York, NY 10022
Phone: (212) 750-2000

COSTA RICA

P210 SAN JOSE
(INC LT) Machinery & Tractors Ltd.
La Uruca
Mail Address: P. O. Box 426
Cable Address: MATRA, SANJOSE
Phone: 21-00-01
Telex No.: C.R. 110

DOMINICAN REPUBLIC

P160 SANTO DOMINGO
(INC LT) Implementos y Maquinarias, C. por A.
Carretera Duarte, Kilometro 5
Mail Address: Apartado 171
Cable Address: IMCA,
SANTODOMINGO
Phone: 809-566-5171
Telex No.: RCA: 4183 IMCA
ITT (AACR): 3460035

ECUADOR

R440 GUAYAQUIL
(INC LT) Importadora Industrial Agricola S.A.
Av. Juan Tanca M., Km. 3
Mail Address: P. O. Box 562
Phone: 384-700
Cable Address: ROSAL GUAYAQUIL
Telex No.: 3215 ROSAL ED

R441 QUITO
Importadora Industrial Agricola S.A.
Panamericana Norte Km 7.5
Mail Address: P. O. Box 2030
Phone: 534-032
Cable Address: ROSAL QUITO
Telex No.: 2164 ROSAL ED

FRENCH GUIANA (Guyane Francaise)

R420 97300 CAYENNE
(INC LT) Yves Massel & Cie.
1.5 Km route de Montabo
Mail Address: Boite Postale No. 171
Cayenne 97300
Guyane Francaise
Phone: 31-29-48
Cable Address: MASSELCO
CAYENNE
Telex No.: 030 527 FG

FRENCH WEST INDIES

P220 GUADELOUPE

97156 POINTE-A-PITRE
(INC LT) Yves Massel & Cie.
Route de Raizet
Mail Address: P. O. Box 210
Cable Address: MASSELY,
POINTEAPITRE
Phone: 82-15-36
Telex No.: 791GA

MARTINIQUE

P110 97207 FORT-DE-FRANCE
Ets. Louis Crocquet
38 Avenue Duparquet
Mail Address: Boite Postale 579
Cable Address: AMGARAGE,
FORTDEFRANCE
Phone: 71-54-54
Telex No.: 029635 MR

GUATEMALA, C.A.

P300 GUATEMALA CITY
(INC LT) Mayatrac, S.A.
Kilometro 11, Carretera a Amatitlan
Mail Address: Apartado Postal 1793
Cable Address: MAYATRAC,
GUATEMALACITY—
VIA TROPICAL
RADIO
Phone: 481061/62/63/64/65
Telex No.: 273 MATRAC GU

GUYANA

R380 GEORGETOWN
(INC LT) Guyana Tractor & Equipment
Company
A Division of Guyana National
Engineering
Corporation Limited
Providence, East Bank, Demerara
Mail Address: P. O. Box 604
Phones: 066/2367/2518/2795/
2796/2797/2798
Cable Address: GUYTRAC
GEORGETOWN
Telex No.: GY238

HAITI

P140 PORT-AU-PRINCE
(INC LT) Haytian Tractor & Equipment
Company.,
S.A.
Ave. Haile Selassie
Mail Address: P. O. Box 1318
Cable Address: HAYTRACTOR,
PORTAUPRINCE
Phones: 61836/61840/61848 & 61849
Telex No.: 3490074

HONDURAS

P341 SAN PEDRO SULA
(INC LT) Casa Comercial Mathews, S.A.
Mail Address: P. O. Box 37
Phone: 52-2059
Cable Address: CEMCOL
SANPEDROSULA
Telex No.: 1109 CEMCOL HT

P340 TEGUCIGALPA
Casa Comercial Mathews, S.A.
Barrio La Bolsa
Comayaguela, D.C.
Mail Address: P. O. Box 39
Cable Address: CEMCOL,
TEGUCIGALPA
Phone: 22-3164
Telex No.: 1109 CEMCOL HT

JAMAICA, W. I.

P190 KINGSTON
(INC LT) Jamaica Tractor & Equipment
Company
379 Spanish Town Road
Mail Address: P. O. Box 213
Cable Address: JAMTRAC,
KINGSTON
Phone: 923-9251
Telex No.: 2135 ALPROJAM

P192 WESTMORELAND
Jamaica Tractor & Equipment Company
Savanna-la-Mar
Mail Address: P. O. Box 60

MEXICO

P260 CHIHUAHUA, CHIHUAHUA
Maquinaria, S.A.
Carretera a Avalos y Calle 2A
Mail Address: Apartado Postal 394
Phone: 5-00-49 and 5-00-51
Telex No.: MAQSA CHI-034837

P261 DURANGO, DURANGO
Maquinaria, S.A.
20 de Noviembre 1401 Ote.
Mail Address: Apartado Postal 106
Phone: 32-05 and 35-80
Telex No.: 066-616

P262 TORREON, COAHUILA
Maquinaria, S.A.
Apartado 412
Blvd. Independencia No. 427 Ote.
Phone: 3-44-48 & 3-43-44
Telex No.: 032-864

MEXICO (Cont.)

P280 CIUDAD OBREGON, SONORA
Maquinaria General del Occidente, S.A.
Sufragio Efectivo y Calle Norte
Mail Address: Apartado Postal No. 24
Phone: 3-68-80
Telex No.: 055807

P281 CULIACAN, SINALOA
Maquinaria General del Occidente, S.A.
Carretera a Navolato Km. 5
Mail Address: Apartado No. 9
Phone: 2-05-80

P286 GUAYMAS, SONORA
Maquinaria General del Occidente, S.A.
Blvd. No. 227, Colonia Aurora
Mail Address: Apartado No. 343
Phone: 2-03-05

P282 HERMOSILLO, SONORA
Maquinaria General del Occidente, S.A.
Carretera Bahia Kino
Mail Address: Apartado Postal No. 75
Phone: 4-00-51 & 4-01-55

P283 LOS MOCHIS, SINALOA
Maquinaria General del Occidente, S.A.
Avenida Bienestar
Mail Address: Apartado No. 54
Phone: 2-38-37

P288 NOGALES, SONORA
Maquinaria General del Occidente, S.A.
Avenida Obregon No. 1738
Mail Address: Apartado Postal No. 584
Phone: 2-10-15

VILLA CONSTITUCION, BAJA CALIFORNIA SUR
Maquinaria General del Occidente, S.A.
Apartado Postal 150
Phone: 2-04-17

P020 GUADALAJARA, JALISCO
(INC LT) Tractores y Maquinaria del Centro, S.A.
Calzada J. Gonzalez Gallo 1335
Mail Address: P. O. Box 1-3777
Cable Address: TRACSA, GUADALAJARA
Phone: 35-92-57
Telex No.: 068-1848

P021 CELAYA, GUANAJUATO
Tractores y Maquinaria del Centro, S.A.
Av. Hidalgo 706
Phone: 2-02-96
Telex No.: 012-820

P024 COLIMA, COLIMA
Tractores y Maquinaria del Centro, S.A.
Zaragoza 402
Phone: 2-10-05

P025 LAZARO CARDENAS, MICHOACAN
Tractores y Maquinaria del Centro, S.A.
Lerdo de Tejada 3

MEXICO (Cont.)

P026 SAN LUIS POTOSI, S.L.P.
Tractores y Maquinaria del Centro, S.A.
Cuauhtemoc 603-B
Phone: 2-76-09

P022 URUAPAN, MICHOACAN
Tractores y Maquinaria del Centro, S.A.
Lazaro Cardenas Sur 740
Phone: 2-16-30

P023 ZACATECAS, ZACATECAS
Tractores y Maquinaria del Centro, S.A.
Av. Gral. Gonzalez Ortega 404
Phone: 2-08-41

P510 MAZATLAN, SINALOA
(E) Distribuidora Rice, S.A.
Carnaval and Nicaragua
Phone: 40-39
Telex No.: 006852

P320 MEXICO 9, D.F.
Mexicana de Tractores y Maquinaria, S.A.
Blvd. Puerto Central Aereo No. 34
Mail Address: Apartado Postal 118 Bis.
Phone: (905) 571-2000
Telex No.: 017-71373

P328 CAMPECHE, CAMPECHE
Mexicana de Tractores y Maquinaria, S.A.
Ave. Lopez Mateos No. 308
Mail Address: Apartado Postal 288
Phone: 43-33

P323 CD. DEL CARMEN, CAMPECHE
Mexicana de Tractores y Maquinaria, S.A.
Calle 20 No. 90
Phone: 2-13-32

P324 COATZACOALCOS, VERACRUZ
Mexicana de Tractores y Maquinaria, S.A.
Carretera Coatzacoalcos-Minatitlan Kilometer 7
Phone: 2-05-66 & 2-05-77

P326 CORDOBA, VERACRUZ
Mexicana de Tractores y Maquinaria, S.A.
Ave. 1 No. 1800
Phone: 2-26-10, 2-21-66 & 2-21-83

P321 MERIDA, YUCATAN
Mexicana de Tractores y Maquinaria, S.A.
Ave. Nachi-Cocom No. 488
Phone: 2-25-01 & 2-11-11

P325 POZA RICA, VERACRUZ
Mexicana de Tractores y Maquinaria, S.A.
Blvd. Lazaro Gardenas No. 1402
Col. Morelos
Phone: 2-05-55 & 2-09-68

P327 SALINA CRUZ, OAXACA
Mexicana de Tractores y Maquinaria, S.A.
Tampico No. 39
Phone: 39

MEXICO (Cont.)

TUXTLA GUTIERREZ, CHIAPAS
Mexicana de Tractores y Maquinaria, S.A.
Avenida Central Pte. 1144
Phone: 2-22-05

P230 MONTERREY, N.L.
(INC LT) Maquinaria Diesel, S.A.
Ave. Eugenio Garza Sada No. 2425 Sur
Mail Address: P. O. Box 692
Phone: 58-23-00
Telex No.: 038-793

P231 MATAMOROS, TAMAULIPAS
Maquinaria Diesel, S.A.
Carretera a C. Victoria Km. 1
Mail Address: P. O. Box 11
Phones: 3-38-59 & 3-05-41

P235 MONCLOVA, COAHUILA
Maquinaria Diesel, S.A.
Carretera 57 y Bravo No. 350
Mail Address: P. O. Box 371
Phone: 3-20-07 & 3-27-60

P233 TAMPICO, TAMAULIPAS
Maquinaria Diesel, S.A.
Carretera Mante-Tampico Km. 148
Mail Address: P. O. Box 45
Phone: 3-13-09 & 3-03-08

P234 CIUDAD MANTE, TAMAULIPAS
Maquinaria Diesel, S.A.
Juarez No. 801 OTE.
Phone: 2-12-94

P236 REYNOSA, TAMAULIPAS
Maquinaria Diesel, S.A.
Blvd. Morelos y Jalapa
Col. Rodriguez
Phone: 2-19-60

P232 SABINAS, COAHUILA
Maquinaria Diesel, S.A.
Calle Francisco I. Madero No. 864
Phone: 2-25-25

CIUDAD VALLES, SAN LUIS POTOSI
Maquinaria Diesel, S.A.
Galeana No. 44
Phone: 2-04-64

NETHERLANDS ANTILLES

R040 CURACAO
(INC LT) PBC Machines & Services Inc.
Schottegat Weg Oost 215
Mail Address: P. O. Box 157
Phones: 43037, 44126
Cable Address: EQUIPMENT
CURACAO
Telex Nos.: 1159 INBA NA,
3308 PBAIZ NA

NICARAGUA, C. A.

P370 MANAGUA
(INC LT) Nicaragua Machinery Company
Mail Address: P. O. Box 469
Cable Address: NIMAC, MANAGUA
Phone: 3151 & 3159
Telex No.: 5811

P371 CHINANDEGA
Nicaragua Machinery Company
Sucursal Chinandega
Phone: 0341-647

P372 LEON
Nicaragua Machinery Company
Sucursal Leon
Phone: 031-3114

P374 OCOTAL
Nicaragua Machinery Company
Sucursal Ocotal
Phone: 158

PANAMA

P050 PANAMA
(INC LT) Cardoze & Lindo, S.A.
Calle 85 y Transistemica
Mail Address: Apartado 7342
Cable Address: CARLINDO,
PANAMA R.
DE PANAMA
Phone: 60-1155
Telex No.: TRT-PA2106,
COMSA/UWI
368715

PARAGUAY

R200 ASUNCION
S.A.C.I. H. Petersen
Pte. Eligio Ayala 481
Mail Address: Casilla de Correo 592
Phones: 92-131/132/133
Cable Address: PARGTRADE
ASUNCION
Telex No.: 263 PY

PERU

R080 LIMA
(INC LT) Enrique Ferreyros & Cia. S.A.
Av. Industrial 675
Mail Address: Apartado 150
Phone: 52-30-70
Cable Address: FERREYCO LIMA
Telex Nos.: 25447, 20102

R083 CHICLAYO
Enrique Ferreyros & Cia. S.A.
Mail Address: P. O. Box 173

PERU (Cont.)

R084 CHIMBOTE
Enrique Ferreyros & Cia. S.A.
Jose Galvez 245

R085 CUZCO
Enrique Ferreyros & Cia. S.A.
Mail Address: P. O. Box 139

R082 ICA
Enrique Ferreyros & Cia. S.A.
Mail Address: P. O. Box 187

R086 IQUITOS
Organizacion Victoria S.A. (ORVISA)
Av. La Marina 2393
Malecon Tarapaca 314
Mail Address: P. O. Box 439
Phone: 2390
Cable Address: ORVISA IQUITOS

R081 PIURA
Enrique Ferreyros & Cia. S.A.
Mail Address: P. O. Box 136

PUERTO RICO

P420 SAN JUAN 00936
USI Puerto Rico, Inc.
John F. Kennedy Avenue
Mail Address: G.P.O. Box 2529
Cable Address: USIPRI
SANJUAN VIA
RCA
Phone: (809) 782-4100
Telex No.: 325-2330 (RCA)

U. S. Office:
U. S. Industries, Inc.
250 Park Avenue
New York, New York 10017
Cable Address: STEELCAR, NEWYORK

P450 SAN JUAN 00936
(LT) Garcia Machinery, Inc.
G.P.O. Box 3368
Cable Address: GARMAC SANJUAN
Phone: 783-3066, Area Code 809
783-4861
Telex No.: GARMAC 3450222-ITT

SALVADOR, EL

P120 SAN SALVADOR
(INC LT) Compania General de Equipos, S.A., de C.V.
Klm. 5 Carretera a Sta. Tecla
Mail Address: Apartado (06) 1000
Cable Address: COGESA,
SANSALVADOR
Phone: 23-23-23
Telex No.: COGESA-20074,
Area Code 301

SURINAM

R350 PARAMARIBO
(INC LT) Surinaamse Machinehandel N.V.
Slangenhoutstraat 57-65
Mail Address: P. O. Box 1808
Phone: 82222
Cable Address: SURMAC
PARAMARIBO
Telex No.: SME 182 SURMAC

TRINIDAD

P310 PORT-OF-SPAIN
Tractors and Machinery (Trinidad) Ltd.
Mail Address: P. O. Box 945
Phones: 31431, 31432,
31433, 31545,
31546, 31547,
31548
Cable Address: TRACMAC
PORTOFSPAIN
TRINIDAD
Telex No.: 308

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(INC LT) General Machinery Co. S.A.
Avenida Joaquin Suarez 2856
Phones: 20-99-21/22/23/24/25
Cable Address: GEMCOSA
MONTEVIDEO
Telex No.: 21284, GEMCOSA UY 730

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(INC LT) General Electric de Venezuela S.A.
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Sabana Grande
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CARACAS
Telex No.: 22724

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Phones: 26010/11/12/13/14
Cable Address: INGENETRIC
BARQUISIMETO
Telex No.: 51116 GE-BTO

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General Electric de Venezuela S.A.
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R403 VALENCIA, EDO. CARABOBO
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R410 U. S. Office:
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Machinery Sales Operation
570 Lexington Avenue
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PLANTRAC INDUSTRIES LTD.
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T231 LAUTOKA
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BANDAR SERIBEGAWAN
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PONTIANAK

BATAM
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Batuampar ± 8Km

TANJUNG KARANG
P. T. Trakindo Utama
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LHOK-SEUMAWE
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Mail Address: P. O. Box 1051
Telex No.: 70106

J285 LAHAD DATU
Tractors Malaysia Berhad
Ground Floor, MDLD0591
Jalan Teratai
Mail Address: P. O. Box 294

J282 MALACCA
Tractors Malaysia Berhad
Lot 20 & 21
Air Keroh Industrial Estate
Mail Address: P. O. Box 219
Telex No.: MA62801

MALAYSIA (Cont.)

J281 MIRI
Tractors Malaysia Berhad
Piasau Road
Mail Address: P. O. Box 352
Telex No.: MA74234

J261 PETALING JAYA
Tractors Malaysia Berhad
Jalan 205
Mail Address: G.P.O. Box 2
Telex No.: MA37610

J263 SANDAKAN
Tractors Malaysia Berhad
Mile 3-1/2 North Road
Mail Address: P. O. Box 1007
Telex No.: MA82003

J283 SIBU
Tractors Malaysia Berhad
17, Khoo Peng Loong Road
Mail Address: P. O. Box 426

J266 TAWAU
Tractors Malaysia Berhad
Mile 4, Apas Road
Mail Address: P. O. Box 780
Telex No.: MA83131

BINTULU
Tractors Malaysia Berhad
18 New Commercial Center
Jalan Abang Galau
Mail Address: P. O. Box 210

NEPAL

Contact:
Tractors India Limited
1 Taratolla Road, Garden Reach
Calcutta 700 024
Mail Address: P. O. Box 323
Cable Address: DIESELS, CALCUTTA

PHILIPPINES

J310 MAKATI, RIZAL
USIPHIL Inc.
P. O. Box 55cc
Cable Address: USIPHIL MAKATI

J312 BACOLOD CITY
USIPHIL Inc.
P. O. Box 206

J313 BUTUAN CITY
USIPHIL Inc.
Km No. 2 National Highway

CAGAYAN DE ORO CITY
USIPHIL Inc.
Philam Life Building
Don Apolinar Velez Street

J314 CEBU CITY
USIPHIL Inc.
Family Savings Bank Bldg
Highway Cor. A. Bonifacio St.
Mandaue City

PHILIPPINES (Cont.)

COTABATO CITY
USIPHIL Inc.
Viola Building
Quezon Avenue

J311 DAVAO CITY
USIPHIL Inc.
P. O. Box 182

ILOILO CITY
USIPHIL Inc.
Carlos Young Bldg.

REPUBLIC OF CHINA (TAIWAN)

J230 TAIPEI
TTC Equipment & Service Ltd.
11th Floor, Kuang Fu Mansion
35 Kuang Fu South Road
Taipei, Taiwan
Mail Address: 36-642, Taipei, Taiwan
Cable Address: TTCES, TAIPEI, TAIWAN
Telex No.: 21581 TTCES

J232 TAINAN
TTC Equipment & Service Ltd.
1-11 Tung Shih Liao
San Hwa Cheng, Tainan Hsien

SINGAPORE, Republic of

J260 Tractors Singapore Limited
(Subidiary of Tractors Malaysia Berhad)
Pioneer Road
Benoi Sector, Jurong
Singapore 22
Mail Address: P.O.Box 170 Jurong
Cable Address: TRACTORS
Telex No.: RS21291 & 21678

Town Office:
Rooms 1107/1108
11th Floor
Malayan Credit House
Somerset Road
Singapore 9
Telex No.: RS24752

CHRISTMAS ISLAND, INDIAN OCEAN
Tractors Singapore Limited
(Subsidiary of Tractors Malaysia Berhad)
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Benoi Sector, Jurong
Singapore 22.
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Cable Address: TRACTORS
Telex No.: RS21291 & 21678

THAILAND

J040 BANGKOK
Metro Machinery Company Limited
1760 Sukumvit Road, Soi 52-54
Prakanong, Bangkok 11
Thailand
Cable Address: METROMAC
BANGKOK
(Thailand)
Telex No.: 7252 METROMAC TH.

LUMPANG
Metro Machinery Company Limited
283 Boonyawat Road
(Opp. Irrigation Dept.)
Amphur Muang, Lumpang

SAMUTSAKORN
Metro Machinery Company Limited
923/25 Kho.
Tambon Mahachai, Amphur Muang
Samutsakorn.

Y600 CATERPILLAR TRACTOR CO. LTD.
YA60

P. O. BOX
GLASGOW G2 1JP, SCOTLAND
Cable Address: CATERPILLAR GLW
Telex No.: 777721
Phone: (069-881) 2921

Y600 Slough Office:
YA60 Caterpillar Tractor Co. Ltd.
Chalfont House
42/44 High Street
Slough
Berks, SL1 1 EL
England
Cable: CATSALES SLOUGH
Telex No.: 849397
Phone: (0753) 38835

Y602 Newcastle Plant:
YA63 Caterpillar Tractor Co. Ltd.
Birtley
Co. Durham DH3 2 QU
England
Cable: CATERPILAR NCLE
Telex No.: 53205
Phone: (0632) 403121

Y601 Leicester Plant:
YA61 Caterpillar Tractor Co. Ltd.
Desford
Leicester LE9 9JT
England
Cable: CATERPILAR LSTR
Telex No.: Lift Truck-(851) 341217
Parts—(851) 34661/2/3
Phone: 2441-2449/2261

London Office:
Caterpillar Tractor Co. Ltd.
55 St. James's Street
London, SW1A 1LA
England
Telex No.: 262931
Cable: CATERPILAR LDN
Phone: (01) 493-1882/3/4/5/6

ENGLAND

V650 WINDSOR, BERKS. SL4 5HH
VA30 (INC LT) H. Leverton & Co. Ltd.
Maidenhead Road
Cable: LEV WINDSOR
Telex No.: 848114
Phone: (07535) 68121

V656 ASHFORD, KENT
VA36 H. Leverton & Co. Ltd.
Chart Road
Phone: (0233) 24571

ASHTON-IN-MAKERFIELD, LANCS.
H. Leverton & Co. Ltd.
615 Wigan Road
Bryn
Telex No.: 67629
Phone: (0942) 76161

V652 BIRTLEY, CO. DURHAM DH3 2DB
VA32 H. Leverton & Co. Ltd.
Durham Road
Telex No.: 53119
Phone: (0632) 402683

V651 LEEDS, YORKS. LS27 7JS
VA31 H. Leverton & Co. Ltd.
Geldard Road
Gildersome
Telex No.: 55170, 55324
Phone: (0532) 534221

V659 SILVERTOWN, LONDON E16 2BY
VA39 H. Leverton & Co. Ltd.
Charles Street
Phone: (01) 474 0927

ENGLAND (Cont.)

V654 SPALDING, LINCOLNSHIRE PE11 2AZ
VA34 H. Leverton & Co. Ltd.
P. O. Box 7
Telex No.: 322270
Phone: (0775) 61100

V655 HALSTEAD, ESSEX
VA35 H. Leverton & Co. Ltd.
Blue Bridge Estate
Colchester Road
Telex No.: 1-987828
Phone: 2678

V658 GREAT YARMOUTH, NORFOLK
VA38 H. Leverton & Co. Ltd.
ABC Wharf
South Quay
Phone: (0493) 58641

V610 CANNOCK, STAFFS, WS11 3LL
VA10 (INC LT) Bowmaker (Plant) Limited
Watling Street
Cable: BOWPLANT CANNOCK
Telex No.: 338523
Phone: (05435)2551

V612 CLAY CROSS, DERBYSHIRE
VA12 Bowmaker Plant Limited
Chesterfield Road
Cable: BOWPLANT CLAYCROSS
Telex No.: 54235
Phone: (0246) 862571

ENGLAND (Cont.)

V613 HIGHBRIDGE, SOMERSET
VA16 Bowmaker (Plant) Limited
Walrow Industrial Estate
Cable: BOWPLANT HIGHBRIDGE
Telex No.: 46397
Phone: (027878) 4991

NR. SALISBURY, WILTSHIRE
Bowmaker (Plant) Limited
Lopcombe Corner
Phone: (026478) 678

ST. AUSTELL, CORNWALL
Bowmaker (Plant) Limited
Bridge Road
Cable: BOWPLANT ST. AUSTELL
Telex No.: 45595
Phone: (0726) 2422

V618 WINSFORD, CHESHIRE
VA18 Bowmaker (Plant) Limited
Winsford Industrial Estate
Cable: BOWPLANT WINSFORD
Telex No.: 667618
Phone: (06065) 4311

WALES

V611 CARDIFF, GLAMORGAN
VA11 Bowmaker (Plant) Limited
Culverhouse Cross
Cable: BOWPLANT CARDIFF
Telex No.: 49217
Phone: (0222) 591411

IRELAND, Republic of

V680 CLONDALKIN, CO. DUBLIN
VA70 (INC LT) McCormick Macnaughton Ltd.
Naas Road, Clondalkin
Cable: SAMAC DUBLIN
Telex No.: 5179
Phone: 514222 DUBLIN

V681 CORK
VA70 McCormick Macnaughton Ltd.
Tivoli
Cable: SAMAC CORK
Telex No.: 6119
Phone: 52252

IRELAND, Northern

V670 BELFAST-BT5 6RT
VB70 (INC LT) McCormick Macnaughton (N.I.) Ltd.
Prince Regent Road
Castlereagh
Cable: SAMAC BELFAST
Telex No.: 74671
Phone: (0232) 59251

SCOTLAND

V630 GLASGOW G69 7TX
VB10 (INC LT) Caledonian Tractor & Equipment Co. Ltd.
Baillieston
Cable: TRACKIPIN GLASGOW
Telex No.: 77243
Phone: (0236) 20111

V631 PERTH, PERTHSHIRE
VB11 Caledonian Tractor & Equipment Co. Ltd.
Lairwell Kinfauns
Cable: TRACKIPIN PERTH
Telex No.: 76145
Phone: Perth 23181

AIRDRIE, ML6 9HT LANARKSHIRE
Caledonian Tractor & Equipment Co. Ltd.
Bellsdyke Lane, Off Cairnhill Road
Phone: (02366) 51111

CALDERCRUIX, LANARKSHIRE
Caledonian Tractor & Equipment Co. Ltd.
Airdrie Road
Phone: (0236) 843133

V632 FRASERBURGH, ABERDEENSHIRE
VB10 Caledonian Tractor & Equipment Co. Ltd.
Shore Street
Balaclava
Phone: Fraserburgh 3931

V634 MUIR-OF-ORD, ROSS-SHIRE
VB10 Caledonian Tractor & Equipment Co. Ltd.
Industrial Estate
Great North Road
Phone: (046382) 575

V633 ABERDEEN, ABERDEENSHIRE
VB12 Caledonian Tractor & Equipment Co. Ltd.
Seaforth Centre
Waterloo Quay
Phone: (0224) 51201

CATERPILLAR MITSUBISHI LTD.

3700, TANA, SAGAMIHARA-SHI
KANAGAWA-KEN, 229
JAPAN
Telex No. J222877
Cable Address: CATERBISHICO SAGAMIHARA
Phone: Sagamihara (0427) 62-1121

BRANCHES:

50000 CHIBA
Caterpillar Mitsubishi Ltd.
East Kanto Branch
313, Toyofuta Kitakanoezuka,
Kashiwa-shi, Chiba-ken
Phone: Kashiwa (0471) 31-1151

51000 TOKYO
Caterpillar Mitsubishi Ltd.
West Kanto Branch
2968-6, Ishikawa-machi,
Hachioji-shi, Tokyo
Phone: Hachioji (0426) 42-1111

52000 OSAKA
Caterpillar Mitsubishi Ltd.
Kinki Branch
146, Oaza-Kori,
Ibaraki-shi, Osaka-fu
Phone: Ibaraki (0726) 43-1121

53000 HIROSHIMA
Caterpillar Mitsubishi Ltd.
Chugoku Branch
7600-1, Nakano, Senogawa-cho,
Hiroshima-shi, Hiroshima-ken
Phone: Senogawa (08289) 3-1111

58000 NIIGATA
Caterpillar Mitsubishi Ltd.
Hokuriku Branch
2307, Aza, Tsutsumitsuki
Oaza-Yamada, Kurosaki-machi,
Nishikanbara-gun, Niigata-ken
Phone: Niigata (0252) 66-9171

55000 NAGOYA
Caterpillar Mitsubishi Ltd.
Tokai Branch
7-41, Higashimukaiyama,
Imahon-machi, Anjo-shi,
Aichi-ken
Phone: Anjo (05667) 8-1111

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P1 HOKKAIDO
Hokkaido Construction Equipment Sales Ltd.
266, Satozuka, Toyohira-ku,
Sapporo-shi, Hokkaido
Phone: Sapporo (011) 881-2321

R1 TOHOKU
Tohoku Construction Equipment Sales. Ltd.
103, Nishihara, Iwanuma-shi,
Miyagi-ken
Phone: Iwanuma (02232) 2-3111

S1 SHIKOKU
Shikoku Construction Equipment Sales Ltd.
3-598, Kukodori
Matsuyama-shi, Ehime-ken
Phone: Matsuyama (0899) 72-1481

T1 KYUSHU
Kyushu Construction Equipment Sales, Ltd.
40, Oaza-Harisuri, Tsukushino-shi
Fukuoka-ken
Phone: Futsukaichi (09292) 4-1211

W1 OKINAWA
Machinato Motor Co., Ltd.
(Construction Equipment Dept.)
664-10, Ajya, Naha-shi,
Okinawa-ken
Phone: Naha (0988) 68-4175

Y500 **CATERPILLAR OVERSEAS S.A.**
YA50 **118, RUE DU RHONE**
1211 GENEVA 3, SWITZERLAND
Telex No.: 22706 & 22833
Cable Address: CATOVERSEA GENEVA
Phone: (022) 20-62-22

Y800 Caterpillar France S.A.
YB80 40-48, Av. Léon Blum
B.P. 55 Centre de Tri
F-38041 Grenoble Cédex
France
Telex No.: 32-890
Cable address: CATERPILAR
Phone: (76) 09-80-00

Y550 Caterpillar Belgium S.A.
YA55 Av. des Etats-Unis 1
B.P. 1
B-6200 Gosselies
Belgium
Telex No.: 51-368
Cable Address: CATERPILAROGOS
Phone: (71) 35-60-60

AFGHANISTAN

Open Territory

ALBANIA

(INC LT) COSA-Geneva

ALGERIA

X230 (INC LT) COSA-Geneva

ANGOLA, Popular Republic of

K450 LUANDA
KC40 (INC LT) Sorel S.à.r.l.
P.O. Box 408
Telex No.: 3229
Cable Address: SOREL LUANDA
Phone: 7-22-81/2/3/4/5

SA DA BANDEIRA
Sorel S.à.r.l.
Caixa Postal 348
Cable Address: SOREL SA DA BANDEIRA

LOBITO
Sorel S.à.r.l.
Caixa Postal 231
Cable Address: SOREL LOBITO

K451 NOVA LISBOA
KC40 Sorel S.à.r.l.
P.O. Box 237
Cable Address: SORELNOV NOVALISBOA

Y750 Caterpillar (Africa)
YA75 (Pty) Ltd.
Anvil Road
P.O. Box 11481
Johannesburg
South Africa
Telex No.: 43-7878/9
Cable Address: ISACAT
Phone: 36-10-11

Y510 Caterpillar Overseas S.A.
YA51 Parts Distribution Center
Humbeeksesteenweg 20
B.P. 1
B-1850 Grimbergen
Belgium
Telex No.: 21151/2/3
Cable Address: CATPA B
Phone: (02) 251-43-10

AUSTRIA

L080 A-2351 WR. NEUDORF (VIENNA)
LA30 (INC LT) Eisner Baumaschinen GmbH
Postfach 100
Strasse No. 1, Objekt 27
Industriezentrum Nö. Sud
Telex No.: 07-9213
Cable Address: EISNERBAUMAGES WIEN
Phone: (2236) 83-5-45

L084 A-9500 VILLACH
LA34 Eisner Villach Vertriebsges, m.b.H.
Untere Fellach
Tiroler Bundesstrasse
Postfach 178
Telex No.: 04-5613
Phone: (04242) 28-4-60/28-8-08

L082 A-8021 GRAZ
LA32 Eisner Graz Vertriebsges. m.b.H.
Waagner-Birostrasse 125
Postfach 1037
Telex No.: 03-1515
Phone: (03122) 51-5-94

L081 A-4021 LINZ
LA31 Eisner Baumaschinen Ges. m.b.H.
Gürtelstrasse 28
Postfach 501
Telex No.: 02-1661
Phone: (07222) 53-5-76

L083 A-6010 INNSBRUCK-RUM
LA33 Eisner Innsbruck Vertriebsges, m.b.H.
Serlesstrasse 3
Postfach 136
Telex No.: 05-3693
Phone: (05222) 61315

AZORES

M380 LISBON, PORTUGAL
MA50 (INC LT) STET-Sociedade Tecnica de
Equipamentos e Tractores S.à.r.l.
Apartado 1351
Telex No.: 12778
Cable Address: STETRA LISBON
Phone: 251-1011

BAHRAIN, ARABIAN GULF

MANAMA
(INC LT) Ahmed & Essa Al-Jalahema
P.O. Box 5357
Telex No.: 299 GJ
Cable Address: BAHAR BAHRAIN
Phone: 713-607

BELGIUM

L400 B-1900 OVERIJSE
LC40 (INC LT) TRECO-Tractor & Equipment
Company S.A.
Steenweg op Brussel 340
Telex No.: 23386
Cable Address: TRECOSA
BRUSSELS
Phone: (02) 687-60-20

LB70 B-1000 BRUSSELS (LT Rental Only)
(LT) Mechanical Equipment Co. S.A.
Rue de l'Abattoir 36
Telex No.: 22300 BRU
Cable Address: EMECEY BRU
Phone: (02) 512-91-35

BENIN, Popular Republic of

K280 COTONOU
KE10 (INC LT) SOGER A.O.
Société Générale de Représentation
Industrielle & de Travaux Publics
B.P. 33
Akpakpa
Zone Industrielle
Telex No.: 5232 ERGENEP
Cable: SOGER AO COTONOU
Phone: 31-33-59 & 31-34-18

K310 Bordeaux Office:
KB30 J. A. Delmas Export S.A.
17, rue Vauban
33075 Bordeaux Cedex
France
Telex No.: 560615
Cable Address: MEA BORDEAUX
Phone: (56) 44-04-24

BOTSWANA

K590 FRANCISTOWN
Botswana Earthmoving Machinery Co.
(Pty) Ltd.
Dumela Industrial Sites, Stand 1111
P. O. Box 137
Telex No.: 212 BD
Cable Address: TRACTORS
FRANCISTOWN,
BOTSWANA
Phone: 547, 681, 682

K591 GABORONE
Botswana Earthmoving Machinery Co.
(Pty) Ltd.
Stand 1226, Industrial Sites
P. O. Box 1616
Telex No.: 423 BD
Cable Address: TRACTORS
GABORONE
Phone: 4161

BULGARIA

X815 (INC LT) COSA-Geneva

BURUNDI, Republic of

K170 BUJUMBURA
KC10 (INC LT) CHANIC
B. P. 930
Cable Address: CHANUSA
BUJUMBURA
Phone: 3284

K150 Kinshasa Office:
Chanic
Direction Générale
B. P. 8512
Kinshasa
Republic of Zaire
Telex No.: 300
Cable Address: CHAMAT KINSHASA
Phone: 59815/59819

K240 Brussels Office:
KC20 Chanic S.A.
Chaussée de la Hulpe 177
1170 Brussels
Belgium
Telex No.: 23078
Cable: CHANIC BRUSSELS
Phone: (02) 673-61-10

CAMEROUN, United Republic of

K610 DOUALA
KE90 (INC LT) S.H.O. Cameroun
Département Tractafric
B. P. 4017
Telex No.: 5217 KN SHOCAM
Cable: TRACTAFRIC DOUALA
Phone: 42-40-83

GAROUA
S.H.O. Cameroun
Département Tractafric
B. P. 56
Telex No.: 7606
TRACTAFRIC GAROUA
Cable: TRACTAFRIC GAROUA
Phone: 27-14-66

YAOUNDE
S.H.O. Cameroun
Département Tractafric
B. P.481
Telex No.: SHO 8274 KN
Cable: TRACTAFRIC YAOUNDE
Phone: 22-47-99

K600 Paris Office:
KB20 Compagnie Optorg
Arago-Défense
S. rue Bellini
92806 Puteaux
France
Telex No.: 620-554 ALTEGRO PUTAU
Cable: OPTORGPO PARIS
Phone: 775-35-43, 775-32-46

CAPE VERDE ISLANDS

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Apartado 1351
Telex No.: 12778
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CENTRAL AFRICAN EMPIRE

K640 BANGUI
KF30 (INC LT) S.H.O. Centrafrique
Département Tractafric
B. P. 959
Telex No.: 5252 (014)
Cable: TRACTAFRIC BANGUI
Phone: 61-19-66, 61-48-00

K600 Paris Office:
KB20 Compagnie Optorg
Arago-Défense
5, rue Bellini
92806 Puteaux
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COMORES ISLANDS

K232 TAN AN ARIVE, MALAGASY
REPUBLIC
Henri Fraise Fils & Cie S.A.
Route des Hydrocarbures
B. P. 28
Telex No.: 22218
Cable: FRAISENRI TANANARIVE
Phone: 227-21/24

K230 Geneva Office:
Overseas Tractors S.A. Ltd.
P. O. Box 111
1211 Geneva 12
Switzerland
Cable Address: TOSA GENEVA
Phone: (022) 47 41 50
Telex No.: 27885 TOSA CH

CONGO, People's Republic of

K620 POINTE NOIRE
KF20 (INC LT) S.H.O. Congo
Département Tractafric
B. P. 697
Telex No.: 8217 (014)
Cable: TRACTAFRIC
POINTENOIRE
Phone: 2867, 2869

K621 BRAZZAVILLE
KB60 S.H.O. Congo
Département Tractafric
B.P. 113
Cable: TRACTAFRIC BRAZZAVILLE
Phone: 2828
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K600 Paris Office:
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5, rue Bellini
92806 Puteaux
France
Telex No.: 620554 ALTERGO PUTAU
Cable: OPTORGPO PARIS
Phone: 775-35-43, 775-32-46

CYPRUS

M050 NICOSIA
MA40 (INC LT) Cyprus Trading Corp. Ltd.
8 Arnalda Street
P. O. Box 1083
Telex No.: 2415
Cable: CYTRACO NICOSIA
Phone: 6-20-21/22

CZECHOSLOVAKIA

101 58 PRAHA 10—Vinohrady
Phoenix Praha A.S.
Ul. Bri Capku 32

DEPARTMENT CATERPILLAR:
X200 18000 PRAGUE 8—LIBEN
XA20 Phoenix Praha A.S.
Pod Plynojemem
Telex No.: 12 25 91
Cable Address: PHOENIX PRAGUE
Phone: Sales: 83 87 90
Service: 83 45 63
Parts: 83 45 63
(LT) COSA-Geneva

DENMARK

L040 2600 GLOSTRUP (COPENHAGEN)
Enmaco A/S
363 Park Alle
P.O. Box 138
Telex No.: 33395
Cable Address: EARTHMOVER
GLOSTRUP
Phone: (2) 45-22-11

L041 8260 VIBY, JYLLAND
(Parts & Service Sales)
Enmaco A/S
Engtoften 16
Phone: (06) 14-55-33
Telex No.: 64395

L042 6700 ESBJERG (Engines)
Enmaco A/S
H. E. Bluhmesvej
Cable Address: CATPOWER ESBJERG
Phone: (05) 13-20-33
Telex No.: 54253

LA10 2650 HVIDOVRE, COPENHAGEN
(LT) Brødrene Vestergaard
Stamholmen 165
Telex No.: 15856/16356
Cable Address: VESTERVAERK
Phone: (01) 78-66-66

DJIBOUTI, Republic of

K020 DJIBOUTI
KG20 (INC LT) Anciens Comptoirs Ries
B. P. 2106
Rue Marchand
Telex No.: 823 FS
Cable Address: RIES DJIBOUTI
Phone: 2467/2455

EGYPT, Arab Republic of

Q620 ALEXANDRIA
QA20 (INC LT) MANTRAC
P. O. Box 1054
22 Amin Fikry Street
Telex No.: 54122 LMTC UN
Cable: LANSOUR ALEXANDRIA
Phone: 26707

ETHIOPIA

K490 ADDIS ABABA
KF70 (INC LT) Ries Engineering Share Co.
P. O. Box 1116
Debrezeit Road
Telex No.: 21082
Cable Address: RIESTRAC
ADDIS ABABA
Phone: 15 11 33

K491 ASMARA, ERITREA
KF70 Paul Ries & Sons (Ethiopia) Ltd.
P. O. Box 738
Cable Address: RIES ASMARA
ERITREA

FINLAND

L390 SF-01530 HELSINKI-VANTAA-LENTO
LB90 (INC LT) Wihuri Oy Witraktor
Telex No.: 12-618
Cable Address: WITRAKTOR
HELSINKI
Phone: (90) 826-311

SF-90520 OULU 52
Wihuri Oy Witraktor
Kansipojantie 3
Cable Address: WITRAKTOR OULU
Phone: (981) 344-235

L391 SF-96100 ROVANIEMI 10
LB91 Wihuri Oy Witraktor
Varastotie 14
Telex No.: 37226
Cable Address: WITRAKTOR
ROVANIEMI
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L392 TAMPERE
LB92 Wihuri Oy Witraktor
SF-33880 Sääksjärvi
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SÄÄKSJÄRVI
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Phone: 723-61-32/723-61-34

LC10 94380 BONNEUIL-SUR-MARNE
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91310 MONTLHERY (Engines)
Hy. Bergerat, Monnoyeur S.A.
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29110 CONCARNEAU
Société Maritime Hy. Bergerat,
Monnoyeur S.A.R.L.
Zone Industrielle du Moros
Telex No.: 940466
Phone: (98) 97-13-88/97-18-62

93212 LA PLAINE SAINT-DENIS
(Parts/Service)
Hy. Bergerat, Monnoyeur S.A.
35, rue Prond'hon
B. P. 53
Telex No.: 620210
Phone: 203-43-30/202-04-69

78480 VERNEUIL-SUR-SEINE
(Training)
Hy. Bergerat, Monnoyeur S.A.
Le Pont du Rouillard
Telex No.: 698075
Phone: (1) 971-56-56

L032 59350 ST. ANDRE-LEZ-LILLE
LC12 Société Lilloise Hy. Bergerat,
Monnoyeur S.A.R.L.
70, rue Pasteur
Telex No.: 810097
Phone: (20) 06-92-01

L037 69200 VENISSIEUX
LC17 Société Lyonnaise Hy. Bergerat,
Monnoyeur S.A.R.L.
30, rue Engène Hénaff
B. P. 544
Telex No.: 340933
Phone: (78) 20-81-23

L034 13480 CABRIES
LC14 Société Marseillaise Hy. Bergerat,
Monnoyeur S.A.R.L.
Route de Gardanne
B. P. No. 1
Telex No.: 410932
Phone: (42) 22-98-25

FRANCE (Cont.)

L036 54840 GONDREVILLE
LC16 Société Nanceienne Hy. Bergerat,
Monnoyeur S.A.R.L.
Route Nationale 4
Telex No.: 850066
Phone: (28) 43-48-30

78480 VERNEUIL-SUR-SEINE
Société Normande Hy. Bergerat,
Monnoyeur S.A.R.L.
Le Pont du Rouillard
Telex No.: 698075
Phone: (1) 971-56-56

94380 BONNEUIL-SUR-MARNE
Société Parisienne Hy. Bergerat,
Monnoyeur S.A.R.L.
2, rue du Moulin Bateau
Telex No.: 220298
Phone: (1) 886-11-21

35530 NOYAL-SUR-VILAINE
Société Rennaise Hy. Bergerat,
Monnoyeur S.A.R.L.
La Croix Mulon
B. P. No. 2
Telex No.: 730097
Phone: (99) 00-52-22

L031 31029 TOULOUSE
LC11 Société Sud-Ouest Hy. Bergerat,
Monnoyeur S.A.R.L.
37, Chemin de la Butte
B. P. No. 4055
Telex No.: 510041
Phone: (61) 80-74-14

GABONESE REPUBLIC

K630 LIBREVILLE
KF10 (INC LT) S.H.O. Gabon
Département Tractafric
B. P. 2147
Telex No.: 5210 (014)
Cable Address: TRACTAFRIC
LIBREVILLE
Phone: 72-01-40/72-04-99/72-11-77

K631 PORT-GENTIL
KF10 S.H.O Gabon
Départment Tractafric
B. P. 520
Cable Address: TRACTAFRIC
PORT-GENTIL

K600 Paris Office:
KB20 Compagnie Optorg
Arago-Défénse
5, rue Bellini
92806 Puteaux
France
Telex No.: 620-554 ALTERGO PUTAU
Cable Address: OPTORGPO PARIS
Phone: 775-35-43/775-32-46

GAMBIA

K360 (INC LT) See SENEGAL
KE50

GERMANY, Federal Republic of

L240 8046 GARCHING bei MUNCHEN
LB10 (INC LT) ZEPPELIN-METALLWERKE GmbH
Zeppelinstrasse 1-5
Postfach 2003
Telex No.: 05215-821
Cable: ZEPPELINMETALL MUNICH
Phone: (89) 3 20 00-1

L249 6320 ALSFELD
Zeppelin-Metallwerke GmbH
Karl-Bröger-Strasse 8
Telex No.: 049-426
Phone: (6631) 844-846

L243 2807 ACHIM
Zeppelin-Metallwerke GmbH
Zeppelinstrasse
Telex No.: 249403
Phone: (4202) 6060

L251 1000 BERLIN 49
LB51 Zeppelin-Metallwerke GmbH
Töpchiner Weg 189-199
Telex No.: 0183-411
Phone: (30) 745-60-61/62

L245 7030 BOEBLINGEN bei STUTTGART
LB15 Zeppelin-Metallwerke GmbH
Hanns-Klemm-Strasse
Telex No.: 07-265-867
Phone: (7031) 22-30-74

L248 8520 ERLANGEN-FRAUENAURACH
LB18 Zeppelin-Metallwerke GmbH
Graf-Zeppelin-Strasse 5-7
Telex No.: 06-29-821
Phone: (9131) 61-51/55

L246 4701 HAMM-RHYNERN
LB16 Zeppelin-Metallwerke GmbH
Zeppelin Strasse 4
Telex No.: 08-28 601
Phone: (2385) 484/488

L253 6450 HANAU
LA21 Zeppelin-Metallwerke GmbH
Donaustrasse 26
Telex No.: 04184189
Phone: (6181) 18 33

L247 5000 KÖLN 90 (PORZ)
LB17 Zeppelin-Metallwerke GmbH
Graf-Zeppelin-Strasse
Postfach 900860
Telex No.: 08-874-451
Phone: (2203) 741

L256 6688 ILLINGEN 2
LA24 Zeppelin-Metallwerke GmbH
Heusweilerstrasse
Telex No.: 04 44115
Phone: (6825) 20 43-47

L250 3014 LAATZEN 4
LB50 Zeppelin-Metallwerke GmbH
Postfach 40
Oesselser Strasse 36
Telex No.: 09-23-693
Phone: (5102) 851

GERMANY (Cont.)

L254 5403 MÜLHEIM-KÄRLICH BEI KOBLENZ
LA22 Zeppelin-Metallwerke GmbH
Industriestrasse
Telex No.: 0867828
Phone: (2637) 6-20-81/85

L255 4200 OBERHAUSEN
LA23 Zeppelin-Metallwerke GmbH
Lindnerstrasse 45 (Neubaugebiet)
Telex No.: 0856988
Phone: (208) 6 58 01-05

L252 2085 QUICKBORN bei HAMBURG
LB52 Zeppelin-Metallwerke GmbH
Zeppelin Strasse 1
Telex No.: 02-12-588
Phone: (4106) 71031

L241 6520 WORMS am RHEIN
LB11 Zeppelin-Metallwerke GmbH
Mainzer Strasse 55
Telex No.: 046-78-37
Phone: (6241) 69 61/69

GERMANY, Democratic Republic of

X840 (INC LT) COSA-Geneva

GHANA

K680 ACCRA
KA90 (INC LT) Tractor & Equipment Division of UAC of Ghana Ltd.
P. O. Box 5207
Cable: MACHTRAC ACCRA
Telex No.: 2008
Phone: 21900

KUMASI
Tractor & Equipment Division of UAC of Ghana Ltd.
P. O. Box 3000
Cable: MACHTRAC KUMASI
Phone: 3307

K666 London Office:
KC70 Unatrac Division of UAC International Ltd.
Maidenhead Road
Windsor
Berks SL4 5HH
Cable: UNATRAC WINDSOR
Telex No.: 848881
Phone: (7535) 55441

GREECE

M010 ATHENS
MC40 (INC LT) AVRAS S.A.
Athinon and Kifissou 162 Aves.
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Omonia Athens
Telex No.: 21-4661/21-4662
Cable: AVRATRAC ATHENS
Phone: 571-6611/572-7011

THESSALONIKI
AVRAS S.A.
297 Monastiriou Street
Telex No.: 041-446
Cable: AVRAS THESSALONIKI
Phone: 516-626

GUINEA BISSAU

M380 LISBON, PORTUGAL
MA50 (INC LT) STET—Sociedade Tecnica de Equipamentos e Tractores S.à.r.l.
Apartado 1315
Telex No.: 12778
Cable: STETRA LISBON
Phone: 251-1011

GUINEE, Republic of

K390 CONAKRY
KE70 (INC LT) Manutention Guinéenne
B. P. 336
Phone: 621-42

K310 Bordeaux Office:
KB30 J. A. Delmas Export S.A.
17, rue Vauban
33075 Bordeaux Cedex
France
Telex No.: 560615
Cable: MEA BORDEAUX
Phone: (56) 44-04-24

HUNGARY

Main Office:

1364 BUDAPEST
Universal Company Ltd.
P. O. Box 54
Phone: 175-433
Telex No.: 22-5347
Cable Address: UNIVERSAL BUDAPEST

X450 Caterpillar Office:

1135 BUDAPEST
Universal Company Ltd.
Jasz Utca 85
Phone: 424-514/882-318

(LT) COSA-Geneva

ICELAND

L130 REYKJAVIK
LB40 (INC LT) HEKLA Ltd.
Laugavegur 170-172
P. O. Box 5310
Telex No.: 2018
Cable: HEKLA REYKJAVIK
Phone: 21240

IRAN

M231 TEHERAN
MC31 (INC LT) Mashinhaye Rahsazi Company Limited
Av. Saadi 168
P. O. Box 3390
Telex No.: 212357
Cable: MARCOLI TEHERAN
Phone: (021) 314001/10

M290 Engine Subdealer:
TEHERAN
Mashinaye Sanati & Abiary Co. Ltd.
Av. Saadi 168
P. O. Box 586
Telex No.: 212108
Cable: MASABCO TEHERAN
Phone: (021) 304927/8

Parts & Service Main Facility:
TEHERAN
Mashinaye Rahsazi Co. Ltd.
18 km Karadj Road
P. O. Box 3390
Telex No.: 212357
Cable: MARCOLI TEHERAN
Phone: (021) 970062/6

TEHERAN (Teheran Branch)
Mashinhaye Rahsazi Co. Ltd.
Serahe Azari
11 km Karadj Road
P. O. Box 3390
Phone: (021) 950712

M232 AHWAZ (Khuzestan Branch)
MC32 Mashinhaye Rahsazi Co. Ltd.
Khorramshahr Road km 8
P. O. Box 101
Cable: MARCOLI AHWAZ
Phone: (061) 33016-18

KERMAN (Kerman Branch)
Mashinhaye Rahsazi Co. Ltd.
Teheran Road km 4
P. O. Box 319
Cable: MARCOLI KERMAN
Phone: (0341) 6770/1

M233 SHIRAZ (Fars Branch)
MC33 Mashinhaye Rahsazi Co.Ltd.
Bushir Road km 2
P. O. Box 168
Cable: MARCOLI SHIRAZ
Phone: (0331) 33993, 36664

IRAN (Cont.)

M234 ESFAHAN (Esfahan Branch)
MC34 Mashinhaye Rahsazi Co. Ltd.
Teheran Road km 2
P. O. Box 156
Phone: (031) 37674, 30031

MASHAD (Khorrassan Branch)
Mashinhaye Rahsazi Co. Ltd.
Cento Road km 9
Cable: MARCOLI MASHAD
Phone: (051) 35008

M230 European Liaison Office:
MC30 AFIWA S.A.
118, rue du Rhône
1211 Geneva 3
Switzerland
Telex No.: 22168
Phone: (022) 35-74-55

IRAQ

X360 (INC LT) COSA-Geneva

ISRAEL

M080 HOLON
The Israel Tractors &
Equipment Co. Ltd.
New Industrial Area
8 Hamanor Street
P. O. Box 214
Telex No.: 35547
Cable: ISRAELEQIP TELAVIV
Phone: 807-722

M081 HAIFA
The Israel Tractors & Equipment Co. Ltd.
P. O. Box 10097
Telex No.: 44730
Cable: ISRAELEQIP HAIFA
Phone: 729-161

MA70 31033 HAIFA
(LT) El Saker Ltd.
33 Haatzmauth Road
P. O. Box 33091
Telex No.: 46678
Cable: SAKEREL HAIFA
Phone: (04) 641-704

ITALY

M040 20123 MILANO
MA30 (INC LT) Compagnia Generale Trattori
S.p.A.
Direzione Generale
Via San Vittore 37
Telex No.: 39073
Cable: COGETRATTORI MILANO
Phone: (02) 49-94

ITALY (Cont.)

M041 20061 MILANO CARUGATE
MA31 Compagnia Generale Trattori S.p.A.
Strada Provinciale 121
P. O. Box 4047
Telex No.: 36478, 36179
Cable: COGETRATTORI CARUGATE
Phone: (02) 904-39-43

M042 13100 VERCELLI
MA32 Compagnia Generale Trattori S.p.A.
Casella Postale 205
Via Torino 45
Telex No.: 20127
Cable: COGETRATTORI VERCELLI
Phone: (0161) 391-265

M046 35030 PADOVA SARMEOLA
MA36 Compagnia Generale Trattori S.p.A.
Via della Provvidenza 129
Telex No.: 43209
Cable: COGETRATTORI PADOVA
Phone: (049) 63-01-88

M043 16149 GENOVA
MA33 Compagnia Generale Trattori S.p.A.
Via R. Rigola 3
Telex No.: 27331
Cable: COGETRATTORI GENOVA
Phone: (010) 25-70-11/12/13

M044 40012 BOLOGNA CALDERARA
DI RENO
MA34 Compagnia Generale Trattori S.p.A.
Via Persicietana 4
Telex No.: 51151
Cable: COGETRATTORI BOLOGNA
Phone: (051) 72-77-25

M045 52040 AREZZO SAN GIULIANO
MA35 Compagnia Generale Trattori S.p.A.
Via Piero Calamandrei 305
Telex No.: 57174
Cable: COGETRATTORI AREZZO
Phone: (0575) 35-08-61

M340 00137 ROME
MA60 (INC LT) Macchine Agricole
Industriali Automezzi MAIA S.p.A.
Via Nomentana 995
Telex No.: 61463, 61404
Cable: MAIAROM
Phone: 82-80-241/4
824-941

M341 70100 BARI
MA61 Macchine Agricole Industriali
Automezzi MAIA S.p.A.
Zona Industriale
S.S. 96, km 118
Telex No.: 81029
Cable: MAIABA
Phone: (080) 451-255

M346 09100 CAGLIARI (SARDINIA)
MA66 Macchine Agricole Industriali
Automezzi MAIA S.p.A.
S.S. 131, km 5500
Telex No.: 79047
Cable: MAIASARD
Phone: (070) 284-821

ITALY (Cont.)

M343 95030 CATANIA (SICILY)
MA63 Macchine Agricole Industriali
Automezzi MAIA S.p.A.
Zona Industriale Contrada Palma
Telex No.: 97012
Cable: MAIACAT
Phone: (095) 344-388

M342 81025 MARCIANISE (CASERTA)
MA62 Macchine Agricole Industriali
Automezzi MAIA S.P.A.
S.S. 87 Sannitica km 21,035
Telex No.: 71108
Cable: MAIANAP
Phone: (0823) 83-21-33

M344 90146 PALERMO (SICILY)
MA64 Macchine Agricole Industriali
Automezzi MAIA S.p.A.
Viale Resurrezione 90/92A
Telex No.: 91048
Cable: MAIASIC
Phone: (091) 46-39-18

M347 65013 CITTA S. ANGELO-PESCARA
MA67 Macchine Agricole Industriali
Automezzi MAIA S.p.A.
Via Nazionale Adriatica Nord
km 439
Telex No.: 60175
Cable: MAIAPE
Phone: (085) 96-80-54

M345 87100 COSENZA
MA65 Macchine Agricole Industriali
Automezzi MAIA S.p.A.
Via Panebianco 282
Telex No.: 80026
Cable: MAIA CS
Phone: (0984) 36-100

Engines and Lift Trucks:
MAIA DPI
S.S. Salaria km 24,400
Monterotondo Scalo (Rome)
Phone: 900-40-29/900-41-42

IVORY COAST

K350 ABIDJAN
KE40 (INC LT) Manutentin Africaine
B. P. 1299
Telex No.: 675
Cable: MEA ABIDJAN
Phone: 37-33-65

K310 Bordeaux Office
KB30 J. A. Delmas Export S.A.
71, rue Vauban
33075 Bordeaux Cedex France
Telex No.: 560615
Cable: MEA BORDEAUX
Phone: (56) 44-04-24

JORDAN

Q210 AMMAN
QB20 (INC LT) Jordan Tractor & Equipment
Company Ltd.
Salt Road
P. O. Box 313
Telex No.: 1226
Cable: JALAD AMMAN
Phone: 61141/42/43

KENYA

K270 NAIROBI
KA80 (INC LT) Construction Eqiupment
(Div. of Gailey & Roberts Ltd.)
P. O. Box 30331
Cable: AFRITRAK NAIROBI
Phone: 55-71-88

ELDORET
Construction Equipment
(Div. of Gailey & Roberts Ltd.)
P. O. Box 27
Cable: AFRITRAK ELDORET
Phone: 2726

KISUMU
Construction Equipment
(Div. of Gailey & Roberts Ltd.)
P. O. Box 1341
Cable: AFRITRAK KISUMU
Phone: 2037

MOMBASA
Construction Equipment
(Div. of Gailey & Roberts Ltd.)
P. O. Box 80592
Cable: AFRITRAK MOMBASA
Phone: 491392

NAKURU
Construction Equipment
(Div. of Gailey & Roberts Ltd.)
P. O. Box 1282
Cable: AFRITRAK NAKURU
Phone: 2796

K666 London Office:
KC70 Unatrac Division of UAC
International Limited
Maidenhead Road
Windsor
Berks. SL4 5HH
England
Telex No.: 848881
Cable: UNATRAC WINDSOR
Phone: (7535) 55441

KUWAIT

Q300 KUWAIT
QB10 (INC LT) Mohamed Abdulrahman
Al-Bahar
Machinery General Office
P. O. Box 148 Safat
Telex No.: 2302 KT
Cable: MOATASIM KUWAIT
Phone: 810-855/56

LEBANON

Q160 BEIRUT
QB50 (INC LT) M. Ezzat Jallad & Fils
P. O. Box 110208 and 112556
Telex No.: JAMLA 21614 & 26124 LE
Cable: JAMLA BEIRUT
Phone: 932 522 (5 lines)

LESOTHO Kingdom of

MASERU
Maluti Tractors (Pty) Ltd.
Box ms 201
Cable: Shipments Lesotho
Phone: Maseru 2643

LIBERIA

K320 MONROVIA
KB50 (INC LT) Liberia Tractor &
Equipment Company
United Nations' Drive
P. O. Box 299
Telex No.: 4282
Cable: LIBTRACO MONROVIA
Phone: 22279/22057

PEOPLE'S SOCIALIST LIBYAN REPUBLIC JAMAHIREYA

Q360 TRIPOLI
QB80 (INC LT) General Company for Farm
Equipment and Agricultural Necessities
(GISMET-EME)
Sidi Masri
P. O. Box 148
Telex No.: 20022
Cable: METRADE TRIPOLI
Phone: 32520, 41237

Q361 BENGHAZI
QB81 General Company for Farm
Equipment and Agricultural Necessities
(GISMET-EME)
P. O. Box 2094
Cable: METRADE BENGHAZI
Telex No.: 40129
Phone: 92329

LIECHTENSTEIN, Principality of

L010 4900 LANGENTHAL, SWITZERLAND
LB20 (INC LT) Ulrich Ammann
Baumaschinen AG
Telex No.: 68446
Cable: AMMANNAG LANGENTHAL
Phone: (063) 29-61-61

LUXEMBOURG, Grand Duchy of

L410 LUXEMBOURG
LD10 (INC LT) Bergerat Dutry S.A.
Zone Industrielle
Howald
Telex No.: 2543
Cable: BEDUTRY LUXEMBOURG
Phone: 48-12-21/22

MADEIRA ISLANDS

M380 LISBON, PORTUGAL
MA50 (INC LT) STET-Sociedade Tecnica de
Equipamentos e Tractores S.à.r.l.
Apartado 1351
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Phone: 251-1011

MALAGASY REPUBLIC

K232 TANANARIVE
Henri Fraise Fils & Cie S.A.
Route des Hydrocarbures
B. P. 28
Telex No.: 22218
Cable: FRAISENRI TANANARIVE
Phone: 227-21/24

K230 Geneva Office:
Overseas Tractors S.A. Ltd.
P. O. Box 111
1211 Geneva 12
Switzerland
Cable Address: TOSA GENEVA
Phone: (022) 47-41-50
Telex No.: 27885 TOSA CH

MALAWI

K581 BLANTYRE
KD91 CESCO Ltd.
Stadium Road
P. O. Box 526
Telex No.: 4140
Cable: CESCO BLANTYRE
Phone: 30166/7/8

LILONGWE
CESCO Ltd.
Kamuzu Procession Road
Plot 7,8 & 9, Area 29
P. O. Box 478
Telex No.: 4109
Phone: 30944

MALAWI (Cont.)

K580 New York Office:
KD90 INTRACO MARKETING CORPORATION
485 Lexington Avenue—10th Floor
New York, N.Y. 10017
Telex No.: 234790 INTRAC-UR (N.Y.)
Phone: (212) 949-9030

MALI REPUBLIC

K380 BAMAKO
KE60 (INC LT) SOMAR
B. P. 143
Telex No.: 565
Cable: MEA BAMAKO
Phone: 22957/22549

K310 Bordeaux Office:
KB30 J. A. Delmas Export S.A.
17, rue Vauban
33075 Bordeaux Cedex
France
Telex No.: 560615
Cable: MEA BORDEAUX
Phone: (56) 44 04 24

MALTA

Open Territory

MAURITIUS

K120 PORT LOUIS
Blyth Brothers & Co. Ltd.
P. O. Box 56
Telex No.: 1W 211
Cable: IBEL MAURITIUS
Phone: 2-0265

MAURITANIA

K300 NOUAKCHOTT
KE20 (INC LT) SOMATRAC
B. P. 164
Telex No.: 571
Phone: 52188

K310 Bordeaux Office:
KB30 J. A. Delmas Export S.A.
17, rue Vauban
33075 Bordeaux Cedex
France
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Cable: MEA BORDEAUX
Phone: (56) 44-04-24

MOROCCO

K370 CASABLANCA
KF40 (INC LT) Société Marocaine des Ets. P. Parrenin
145, Bd. de la Résistance
Telex No.: 21733
Cable: PARAGRI CASABLANCA
Phone: 24-56-75

MOZAMBIQUE, Popular and Democratic Republic of

K460 MAPUTO
KA40 (INC LT) Sociedade Tecnica de Equipamentos Industriais e Agricolas Lda. (STEIA)
P. O. Box 2864
Telex No.: 6241 (393)
Cable: REMOTERRA MAPUTO
Phone: 21308/24254

K463 BEIRA
Sociedade Tecnica de Equipamentos Industriais e Agricolas (Beira) Lda.
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Telex No.: 2341
Cable: STEIA BEIRA
Phone: 24062/22462

K462 NAMPULA
Sociedade Tecnica de Equipamentos Industriais e Agricolas (Nampula) Lda.
P. O. Box 416
Cable: STEIA NAMPULA
Phone: 3006/9

K461 TETE
Sociedade Tecnica de Equipamentos Industriais e Agricolas (Tete) Lda.
P. O. Box 169
Cable: STEIA TETE
Phone: 20 and 312

NETHERLANDS

L110 AMSTERDAM-O
Geveke Motoren en Grondverzet B.V.
Spaklerweg 45
Industrieterrein Amstel
Postbus 4091
Telex No.: 13106
Cable: GLOBETRACT AMSTERDAM
Phone: (020) 94-32-32

NETHERLANDS (Cont.)

L111 Engine Division:
AMSTERDAM
Geveke Motoren en Grondverzet
B.V.
Divisie Motoren
Kabelweg 25
Postbus 1225
Telex No.: 12219
Phone: (020) 80-28-02

L122 Parts and Service Main Facility
Engine Division:
3356 LE PAPENDRECHT
Geveke Motoren en Grondverzet B.V.
Ketelweg 20
Postbus 61
Telex No.: 29401
Phone: (078) 5-05-55

VALKENSWAARD
Geveke Motoren en Grondverzet
B.V.
J.F. Kennedy Laan 40
Industrieterrein Deschaapsloop
Phone: 04902/8158

LA40 ROTTERDAM 22
(LT) Handelsonderneming Mageon B.V.
Sluisjesdijk 70
Telex No.: 23 483
Cable: MAGEON ROTTERDAM
Phone: (010) 29-29-55

NIGER

K410 NIAMEY
KE80 (INC LT) Manutention Africaine
B. P. 136
Telex No.: 5234
Phone: 72-20-11/72-20-12

K310 Bordeaux Office:
KB30 J. A. Delmas Export S.A.
17, rue Vauban
33075 Bordeaux
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Telex No.: 560615
Cable: MEA BORDEAUX
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NIGERIA

K660 LAGOS
KB91 (INC LT) Tractor & Equipment Division of the UAC of Nigeria Ltd.
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Ebute-Metta
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Phone: 43310
Telex No.: 21233

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Telex No.: 71170

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Tractor & Equipment Division of the UAC of Nigeria Ltd.
Trans Amadi Estate
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Phone: 21627/8

WARRI
Tractor & Equipment Division of the UAC of Nigeria Ltd.
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Phone: 5191

KANO
Tractor & Equipment Division of UAC of Nigeria Ltd.
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Cable: UNATRAC KANO

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KC70 Unatrac Division of UAC
International Limited
Maidenhead Road
Windsor
Berks SL4 5HH
England
Telex No.: 848881
Cable: UNATRAC WINDSOR
Phone: (7535) 55441

NORWAY

L310 OSLO 5
Pay & Brinck A/S
Brobekkvn. 62B
P. O. Box 65, Rislókka
Telex No.: 11631
Cable: PABRIMAS OSLO
Phone: (2) 15-92-50

L312 BERGEN
Pay & Brinck A/S
5090 Nyborg i Åsane
Telex No.: 42536
Phone: (5) 18-47-00

2380 BRUMUNDDAL
Pay & Brinck A/S
Mausetvegen 2
Telex No.: 19405
Phone: (65) 40-511/12

4600 KRISTIANSAND S
Pay & Brinck A/S
Aegirsvei 3
Telex No.: 18202
Phone: (42) 92-555

NORWAY (Cont.)

L314 8501 NARVIK
Pay & Brinck A/S
Fagernesveien 3
P. O. Box 278
Telex No.: 64276
Phone: (82) 44-135

L315 7001 TRONDHEIM-GRANÅSLIA
Pay & Brinck A/S
Bromstadveien 70
P. O. Box 3723
Telex No.: 55136
Phone: (75) 15-740

LA70 OSLO 6
(LT) Maskin A/S K. Lund & Co.
Ryensvingen 2
Telex No.: 19892 KLUCO
Cable: ISOLATION OSLO
Phone: (2) 42-08-00

OMAN, Sultanate of

MUSCAT
(INC LT) Oasis Trading & Equipment Company
P. O. Box 1002
Mutrah
Telex No.: 329 ALFAIHA MB
Phone: 2160

PAKISTAN

M130 KARACHI 1
MD30 (INC LT) Allied Engineering and Services Ltd.
G.P.O. Box 940
Telex No.: 3623 PHPL PW
Cable: BULLWORK
Phone: 514985

LAHORE
Allied Engineering and Services Ltd.
59 Main Gulberg
Phone: 80641

RAWALPINDI
Allied Engineering and Services Ltd.
39 Al-Abbas Square
Adamji Road
Phone: 63132

POLAND

X330 CANNOCK, STAFFS., U.K.
XA30 (INC LT) Bowmaker (Plant) Ltd.
Polish Operations Division
Watling Street
Telex No.: 337548
Cable: BOWPLANT CANNOCK
Phone: 2551

POLAND (Cont.)

X331 00-193 WARSAW
XA31 (INC LT) Bowmaker (Plant) Ltd.
Biuro Informacji Technicznej
U1. Stawki 2
"INTRACO" p. XVI
Telex No.: 814-899
Phone: 39-64-02, 39-71-62,
39-56-38

Consignment Stock Parts Warehouse:
Bowmaker Service Station
Hydrobudowa 7
Ul. Zielona 6
Umultowo K. Poznania
Poland
Telex No.: 04-15-574 BOWMA PL
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Staffordshire WS11 3LL
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Cable Address: BOWPLANT CANNOCK
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PORTUGAL

M380 LISBON
MA50 (INC LT) STET-Sociedade Tecnica de Equipamentos e Tractores S.à.r.l.
Apartado 1351
Telex No.: 12778
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Phone: 251-1011

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MA51 Sociedade Tecnica de Equipamentos e Tractores S.à.r.l.
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Cable: STETRA PORTO
Phone: 948-1560

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Phone: 25055

BEJA
Sociedade Tecnica de Equipamentos e Tractors S.à.r.l.
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Telex No.: 18250
Phone: 24075

COIMBRA
Sociedade Tecnica de Equipamentos e Tractores S.à.r.l.
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Phone: 27976

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Tractores S.à.r.l.
Vale de Serves
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PRINCIPE ISLAND

K450 LUANDA, ANGOLA
KC40 (INC LT) Sorel S.à.r.l.
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DOHA
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Phone: 21026

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K340 97462 ST. DENIS
KC30 (INC LT) Ets Camille Macé S.A.
46, rue de la Bourdonnais
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Telex No.: 38 RE
Cable: CEMACE STDENIS
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Barlow's Tractor & Equipment Co. Ltd.
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Beverley East
Msasa
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Telex No.: 4368
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K502 BULAWAYO
Barlow's Tractor & Equipment Co. Ltd.
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Telex No.: 3152
Phone: 67781

RIO MUNI (Spanish Guinea)

M180 MADRID 14, SPAIN
MB40 (INC LT) Finanzauto S.A.
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Telex No.: 27752
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Phone: (91) 448-2700

RUMANIA

X940 (INC LT) COSA-Geneva

RWANDA

K170 BUJUMBURA, BURUNDI
KC10 (INC LT) CHANIC
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Phone: 3284

K150 Kinshasa Office:
Chanic
Direction Générale
B. P. 8512
Kinshasa
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Telex No.: 300
Cable: CHAMAT KINSHASA
Phone: 59815/59819

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KC20 Chanic S. A.
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Phone: 7-22-81/2/3/4/5

SAUDI ARABIA

Q630 JEDDAH
QD30 (INC LT) Zahid Tractor & Heavy Machinery
Company Ltd.
P. O. Box 1588
Telex No.: 40042 ZAHTRAC SJ
Cable: ZAHIDTRACTOR JEDDAH
Phone: 77000, 76366, 76420

Q633 DAMMAM
QD33 Zahid Tractor & Heavy Machinery
Company Ltd.
P. O. Box 579
Telex No.: 60080 ZAHTRAC SJ
Cable: ZAHIDTRACTOR DAMMAM
Phone: 22594

Q632 RIYADH
QD32 Zahid Tractor & Heavy Machinery
Company Ltd.
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Telex No.: 20129
Cable: ZAHIDTRACTOR RIYADH
Phone: 20129

SENEGAL, Republic of

K360 DAKAR
KE50 (INC LT) LABO Afrique
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SIERRA LEONE

K690 FREETOWN
KC90 (INC LT) Tractor & Equipment Division of the UAC of Sierra Leone Ltd.
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Cable: UNATEC FREETOWN
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K666 London Office:
KC70 Unatrac Division of UAC International Limited
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Cable: UNATRAC WINDSOR
Phone: (7535) 55441

SOMALI DEMOCRATIC REPUBLIC

K130 MOGADISCIO
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(from 3 a.m.—9 p.m.)
Cable: BOERO MAGADISCIO
Phone: 80997

Rome Office:
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Phone: 86-74-68

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K030 JOHANNESBURG 2000
Barlow's Tractor Division
Division of Barlow Rand Limited
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Cable: BARWING JOHANNESBURG
Phone: 39-4511

K040 ISANDO 1600
Barlow's Tractor & Machinery Co.
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Telex No.: 8-7872, 8-7940,
8-8507
Phone: 36-3011
Cable Address: SHIPMENTS ISANDO

K110 SILVERTON 0127
Barlow-Noordelik Masjinerie Maatskappy
316 Mundt Street
Waltloo
Pretoria P. O. Box 518
Telex No.: 3-0321
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Phone: 83-1171

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Phone: 3264/5/6

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K115 LICHTENBURG 2740
Barlow's Noordelik Masj. Mpy.
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K050 NATAL 3600
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Telex No.: 56-5322
Cable: SHIPMENTS DURBAN
Phone: 72-1341

K061 EMPANGENI, ZULULAND
Barlow's (Natal) Ltd.
Old Matubatuba Road
Telex No.: DX248
Phone: 530

K053 VRYHEID, NATAL 3100
Barlow's (Natal) Ltd.)
149 President Str.
Telex No.: 56-7782
Phone: 1351

K080 PORT ELIZABETH 6001
Barlow's (Eastern Province) Ltd.
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Struandale
P. O. Box 2006
Telex No.: 74-7521/74-7522
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ELIZABETH
Phone: 42-1001

K085 EAST LONDON
Barlow's Earthmoving Equip. Co.
(Border) Ltd.
Wilsonia
Telex No.: 57-5733
Phone: 45-1713

K086 KOKSTAD
Barlow's Earthmoving Equip. Co.
(Border) Ltd.
Cor. Groome & Hawthorne Str.
Telex No.: DS7095
Phone: 370

K082 GEORGE, CAPE 6530
Barlow's (E.P.) Ltd.
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Phone: 4937

SOUTH AFRICA (Cont.)

K060 CAPE 7530
Barlow's (Cape) Limited
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Bellville South
Telex No.: 5-7968/5-7969
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Phone: 97-5931

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Phone: 426/7

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Barlow's Northern Cape Ltd.
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Welder Street
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Phone: 23157

K011 UPINGTON 8800
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Industrial Rd.
Telex No.: 558-464
Phone: 3272/3873

K012 POSTMASBURG 8420
Barlow's Northern Cape Ltd.
Chroom Rd.

K070 BLOEMFONTEIN 9300
Barlow's (OFS) Ltd.
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Telex No.: 52-631
Cable: SHIPMENTS
BLOEMFONTEIN
Phone: 82721

SOUTH WEST AFRICA

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Cable: SHIPMENTS WINDHOEK
Phone: 32026

WALVIS BAY
Barlow's S.W.A. Tractor Co.
4th Street East
Telex No.: 48-096
Cable: SHIPMENTS WALVIS
BAY
Phone: 4391

SPAIN

M180 MADRID 14
MB40 (INC LT) Finanzauto S. A.
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M181 ARGANDA
MB41 Finanzauto S. A.
Arganda del Rey (Madrid)
Telex No.: 23200
Teletypes: 10031/33/36/49
Phone: (910) 8712612

M182 BARCELONA
MB42 Finanzauto S. A.
Sta. Perpetua de Moguda
(Barcelona)
Teletype: 10050
Phone: (93) 5600298/560090

M185 BILBAO
MB45 Finanzauto S. A.
Amorebieta (Vizcaya)
Teletype: 10040
Phone: (94) 6730500

M186 LA CORUNA
MB46 Finanzauto S. A.
Bergondo (La Coruna)
Teletype: 10043
Phone: (981) 780151/780126

M188 LAS PALMAS, CANARY ISLANDS
MB48 Finanzauto S. A.
Parcelacion Industrial
"El Goro"
Telde (Gran Canaria)
Telex No.: 95124
Phone: (928) 692-850

M190 MALAGA
MA90 Finanzauto S. A.
Poligono Industrial "Sta. Teresa"
(Malaga)
Teletype: 10035
Phone: (952) 270-450/271-654

M191 OVIEDO
MA91 Finanzauto S. A.
Lugones (Asturias)
Teletype: 10037
Phone: (985) 260-250

LERIDA
Finanzauto S. A.
Poligono Industrial "El Segre"
Teletype: 10045
Phone: (973) 200-594

PALMA DE MALLORCA
Finanzauto S. A.
Poligono Industrial "La Victoria"
"Son Castello" Palma de Mallorca
Teletype: 10034
Phone: (971) 256-056/255-819

M183 SEVILLA
MB43 Finanzauto S. A.
Dos Hermanas (Sevilla)
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Phone: (954) 721-350

SPAIN (Cont.)

M189 TENERIFE, CANARY ISLANDS
MB49 Finanzauto S. A.
Sta. Cruz de Tenerife
Telex No.: 92117
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M184 VALENCIA
MB44 Finanzauto S. A.
Chiva (Valencia)
Teletype: 10042
Phone: (96) 2520275

M193 ZARAGOZA
MA93 Finanzauto S. A.
Poligono Industrial de Cogullada
Avda. Fco. Caballero 29
Teletype: 10032
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SUDAN

Q390 KHARTOUM
Sudanese Tractor Company Ltd.
74 Barlaman Avenue
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Cable: TRACTORS KHARTOUM
Telex No.: 511 TRACTORS KM
Phone: 72828

Q391 WAD MEDANI
Sudanese Tractor Company Ltd.
P. O. Box 301
Cable: TRACTORS WAD MEDANI
Phone: 639 and 2416

SWAZILAND

K114 MANZINI
Barlow's (Swaziland) (Pty) Ltd.
P. O. Box 120
Telex No.: SMX 2063
Cable: Shipments Manzini
Phone: 2363

SWEDEN

L100 S-172 20 SUNDBYBERG
LB30 (INC LT) ENGSON
Engström & Nilson Maskin AB
Fack
Cable: ENGSON STOCKHOLM
Telex No.: 1544 (General)
1506 (Parts)
Phone: (8) 28-25-60

Parts and Service:
19400 UPPLANDS-VÄSBY
Engström & Nilson Maskin AB
Jupitervägen 10
Telex No.: 13540
Phone: (760) 86020

SWEDEN (Cont.)

L103 96100 BODEN
LB33 Engström & Nilson Maskin AB
Hantverkaregatan 2
Telex No.: 8306
Cable: ENGSON BODEN
Phone: (921) 1-36-60

L101 24100 ESLÖV
LB31 Engström & Nilson Maskin AB
Järnvägsgatan 4 Box 38
Telex No.: 3143
Cable: ENGSON ESLOV
Phone: (413) 1-30-70

L102 40252 GOTEBORG 13
LB32 Engström & Nilson Maskin AB
P. O. Box 13071
Telex No.: 2393
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Phone: (31) 44-72-00

L104 85253 SUNDVALL
LB34 Engström & Nilson Maskin AB
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Phone: (60) 15-03-40

L107 67400 VETLANDA
LB37 Engström & Nilson Maskin AB
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SWITZERLAND

L010 4900 LANGENTHAL
LB20 (INC LT) ULRICH AMMANN
Baumaschinen AG
Telex No.: Sales: 68446
Parts & Service: 68385
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Phone: (063) 29-61-61

L012 1604 PUIDOUX
LB21 ULRICH AMMANN Service S.A.
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Q170 DAMASCUS
QC50 (INC LT) M. Ezzat Jallad & Fils
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Al-Qaboun
P. O. Box 23
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Telex No.: 19148 SY
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Q172 ALEPPO
QC50 M. Ezzat Jallad & Fils
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TANZANIA

K260 DAR ES SALAAM
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Division of the UAC of Tanzania Ltd.
P. O. Box 2568
Cable: AFRITRAK DAR
ES SALAAM
Phone: 64531

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Construction Equipment Division of
the UAC of Tanzania Ltd.
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UMTATA
Transkei Tractors (Pty.) Ltd.

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M141 ADANA
MB31 Cukurova Ithalat ve Ihracat T.A.S.
Hava Alani Karsisi No. 420
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Phone: 14723
Telex No.: 62156

M142 ANKARA
MB22 Eskisehir Yolu 9 km. No. 80/1
Telex No.: 42364
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Phone: 23-11-00

M143 IZMIR
MB33 Cukurova Ithalat ve Ihracat T.A.S.
Gazi Bulvari No. 29
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Phone: 149159
Telex No.: 52325

DIYARBAKIR
Cukurova Ithalat ve Ihracat T.A.S.
Inonu Cad. No. 45/B
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Phone: 59441

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QB11 (INC LT) Mohamed Abdulrahman
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207-2625/207-2982

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Cable: TRADCO HODEIDAH
Phone: 2406

SANAA
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XA90 (INC LT) OMNIKOMERC
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41000 ZAGREB
OMNIKOMERC
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Phone: 59815/59819

K160 KINSHASA
KB10 CHANIMAT (Main Store)
B. P. 11.197
Telex No.: Chanic 300
Cable: CHANIMAT KINSHASA
Phone: 59811

K161 BOMA
KB10 CHANIMAT
B. P. 90
Cable: CHANIMAT BOMA

KISANGANI
CHANIMAT
B. P. 10
Cable: CHASTAN KISANGANI

BUKAVU
CHANIMAT
B. P. 2374
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DA FORM 1 JUL 79 2028-2

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P.S.--IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR RECOMMENDATION MAKE A CARBON COPY OF THIS AND GIVE IT TO YOUR HEADQUARTERS.

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TEAR ALONG PERFORATED LINE

Chart Transposed to

End of Volume.

THE METRIC SYSTEM AND EQUIVALENTS

LINEAR MEASURE

1 Centimeter = 10 Millimeters = 0.01 Meters = 0.3937 Inches
1 Meter = 100 Centimeters = 1000 Millimeters = 39.37 Inches
1 Kilometer = 1000 Meters = 0.621 Miles

WEIGHTS

1 Gram = 0.001 Kilograms = 1000 Milligrams = 0.035 Ounces
1 Kilogram = 1000 Grams = 2.2 Lb
1 Metric Ton = 1000 Kilograms = 1 Megagram = 1.1 Short Tons

LIQUID MEASURE

1 Milliliter = 0.001 Liters = 0.0338 Fluid Ounces
1 Liter = 1000 Milliliters = 33.82 Fluid Ounces

SQUARE MEASURE

1 Sq Centimeter = 100 Sq Millimeters = 0.155 Sq Inches
1 Sq Meter = 10,000 Sq Centimeters = 10.76 Sq Feet
1 Sq Kilometer = 1,000,000 Sq Meters = 0.386 Sq Miles

CUBIC MEASURE

1 Cu Centimeter = 1000 Cu Millimeters = 0.06 Cu Inches
1 Cu Meter = 1,000,000 Cu Centimeters = 35.31 Cu Feet

TEMPERATURE

$5/9\,({}^{0}F - 32) = {}^{0}C$
212° Fahrenheit is equivalent to 100° Celsius
90° Fahrenheit is equivalent to 32.2° Celsius
32° Fahrenheit is equivalent to 0° Celsius
$9/5\,C^{0} + 32 = F^{0}$

0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
CM.
1
2
3
4
5
6
INCHES
TA089991

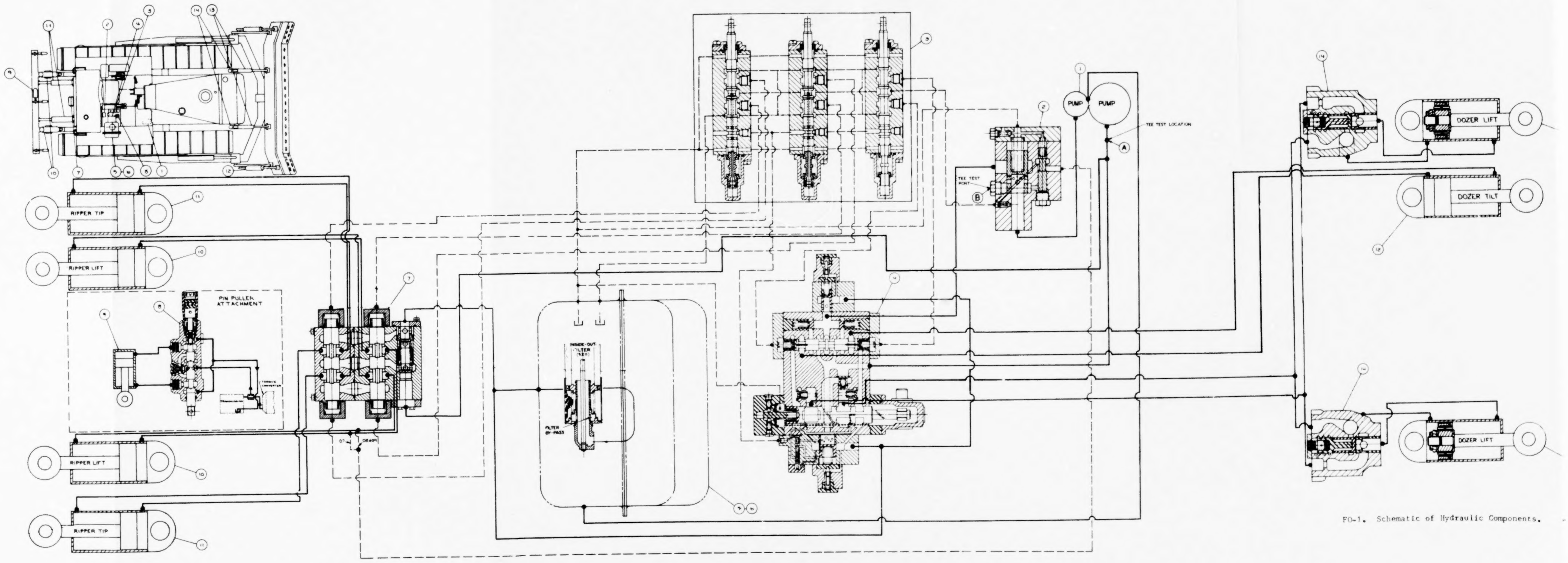
APPROXIMATE CONVERSION FACTORS

TO CHANGE	TO	MULTIPLY BY
Inches	Centimeters	2.540
Feet	Meters	0.305
Yards	Meters	0.914
Miles	Kilometers	1.609
Square Inches	Square Centimeters	6.451
Square Feet	Square Meters	0.093
Square Yards	Square Meters	0.836
Square Miles	Square Kilometers	2.590
Acres	Square Hectometers	0.405
Cubic Feet	Cubic Meters	0.028
Cubic Yards	Cubic Meters	0.765
Fluid Ounces	Milliliters	29.573
Pints	Liters	0.473
Quarts	Liters	0.946
Gallons	Liters	3.785
Ounces	Grams	28.349
Pounds	Kilograms	0.454
Short Tons	Metric Tons	0.907
Pound-Feet	Newton-Meters	1.356
Pounds per Square Inch	Kilopascals	6.895
Miles per Gallon	Kilometers per Liter	0.425
Miles per Hour	Kilometers per Hour	1.609

TO CHANGE	TO	MULTIPLY BY
Centimeters	Inches	0.394
Meters	Feet	3.280
Meters	Yards	1.094
Kilometers	Miles	0.621
Square Centimeters	Square Inches	0.155
Square Meters	Square Feet	10.764
Square Meters	Square Yards	1.196
Square Kilometers	Square Miles	0.386
Square Hectometers	Acres	2.471
Cubic Meters	Cubic Feet	35.315
Cubic Meters	Cubic Yards	1.308
Milliliters	Fluid Ounces	0.034
Liters	Pints	2.113
Liters	Quarts	1.057
Liters	Gallons	0.264
Grams	Ounces	0.035
Kilograms	Pounds	2.205
Metric Tons	Short Tons	1.102
Newton-Meters	Pound-Feet	0.738
Kilopascals	Pounds per Square Inch	0.145
Kilometers per Liter	Miles per Gallon	2.354
Kilometers per Hour	Miles per Hour	0.621

NO.	MACHINE NO.	PART NO.	NAME	DESCRIPTION	[illegible]	[illegible]	STROKE
1	D7	7J4694	PUMP	DOUBLE PUMP-54.5 GPM & 24.0 GPM			
	D8	7J612	PUMP	DOUBLE PUMP-49.2 GPM & 22.4 GPM			
	D9	7J5409	PUMP	DOUBLE PUMP-68.0 GPM & 22.0 GPM			
2	D7, D8, D9	9J5881	RESTRICTOR VALVE	PROVIDES PILOT PRESSURE			
3	D7, D8, D9	8J8601	PILOT VALVE GROUP	RIPPER LIFT ONLY			
	D8, D9	8J8602	PILOT VALVE GROUP	RIPPER LIFT AND RIPPER TIP			
	D7, D8, D9	8J7488	PILOT VALVE GROUP	TILT ONLY			
	D7, D8, D9	8J7489	PILOT VALVE GROUP	TILT AND RIPPER LIFT			
	D8, D9	8J7487	PILOT VALVE GROUP	TILT RIPPER LIFT AND RIPPER TIP			
4	D7	9J7144	CONTROL VALVE	DOZER LIFT AND TILT CONTROL VLV			
	D8	8J7489	CONTROL VALVE	DOZER LIFT AND TILT CONTROL VALVE			
	D9	9J7143	CONTROL VALVE	DOZER LIFT AND TILT CONTROL VLV			
5	D7, D8	8J8728	TANK AND FILTER GP				
	D9	8J8729	TANK AND FILTER GP				
6	D7	9J7153	TANK AND VALVE GP	A415			
	D8	8J8649	TANK AND VALVE GP	A993			
	D9	8J8690	TANK AND VALVE GP	A994			
7	D9	8J8990	CONTROL VALVE	RIPPER LIFT ONLY			
	D7, D8	9J2918	CONTROL VALVE	RIPPER LIFT ONLY			
	D9	8J8979	CONTROL VALVE	RIPPER LIFT AND RIPPER TIP			
	D8	9J2919	CONTROL VALVE	RIPPER LIFT AND RIPPER TIP			
8	D8, D9	8J8744	CONTROL VALVE	PIN PULLER CONTROL VALVE			
9	D8, D9	8J2071	CYLINDER GROUP	PIN PULLER CYL	4.00	1.90	9.90
10	D7	9J4439	CYLINDER GROUP	RIPPER LIFT CYL	6.00	2.50	14.70
	D8	7J5221-22	CYLINDER GROUP	RIPPER LIFT CYL	8.25	3.25	18.00
	D9	7J4487-88	CYLINDER GROUP	RIPPER LIFT CYL	9.25	3.25	21.05
11	D8	6J9129	CYLINDER GROUP	RIPPER TIP CYL	7.25	3.00	16.90
	D9	6J7810	CYLINDER GROUP	RIPPER TIP CYL	8.25	3.50	20.67
12	D7	6J9792	CYLINDER GROUP	DOZER TILT CYL	6.90	3.00	6.00
	D8	9J8682	CYLINDER GROUP	DOZER TILT CYL	8.25	3.50	7.40
	D9	6J9510	CYLINDER GROUP	DOZER TILT CYL	8.25	3.50	7.00
13	D7	7J9999-94	CYLINDER GROUP	DOZER LIFT CYL	4.75	2.50	57.62
	D7 LGP	9J4817-18	CYLINDER GROUP	DOZER LIFT CYL	4.75	2.50	46.31
	D8	8J8584-85	CYLINDER GROUP	DOZER LIFT CYL	5.00	2.75	66.00
	D9	9J9097	CYLINDER GROUP	DOZER LIFT (S.U)	6.25	3.00	70.12
	D9	9J2897	CYLINDER GROUP	DOZER LIFT (A)	6.25	3.00	70.12
14	D7	9J9869	VALVE GROUP	QUICK DROP VALVE			
	D8	6J6608	VALVE GROUP	QUICK DROP VALVE			
	D9	9J4849	VALVE GROUP	QUICK DROP VALVE			

	RELIEF VALVE SETTINGS	
	TILT CIRCUIT	DOZER CIRCUIT
D7G	2450 ± 75 PSI	2250 ± 75 PSI
D8H	2500 ± 75 PSI	2400 ± 75 PSI
D9H	2450 ± 75 PSI	2250 ± 75 PSI



FO-1. Schematic of Hydraulic Components.